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PC AUSTRALIA

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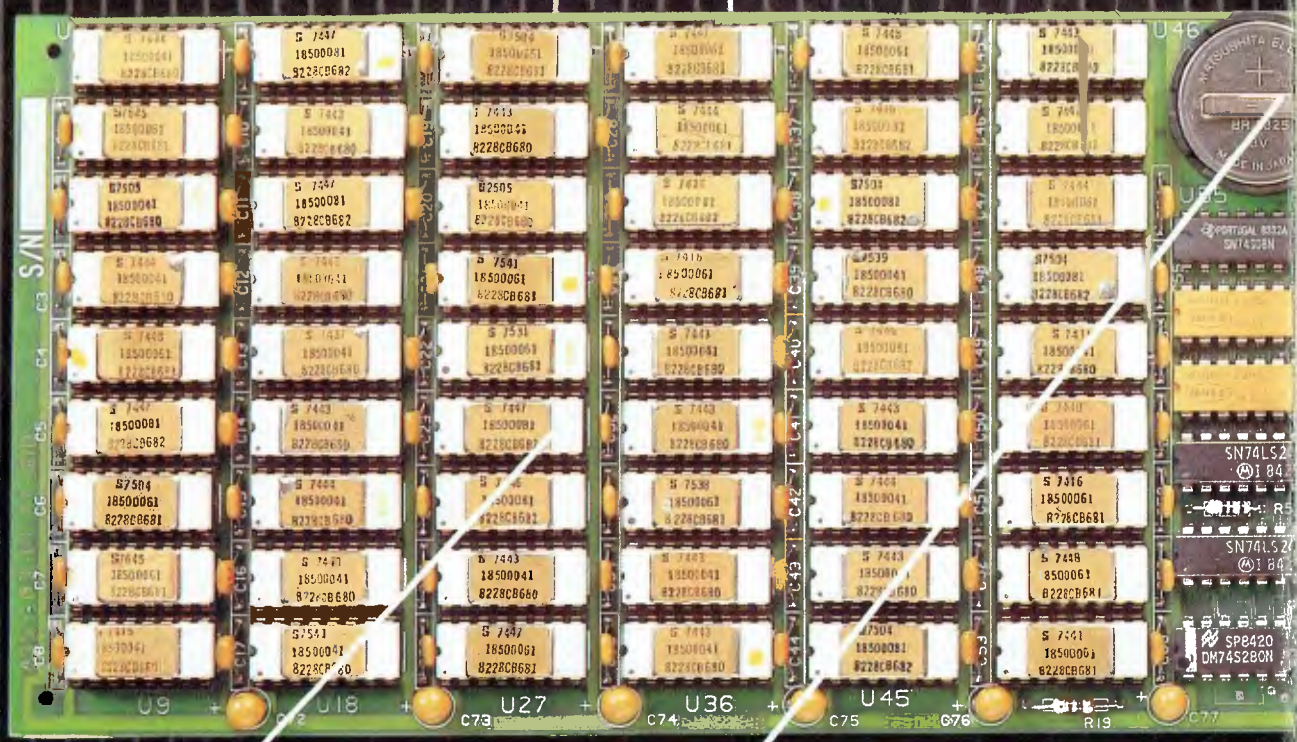

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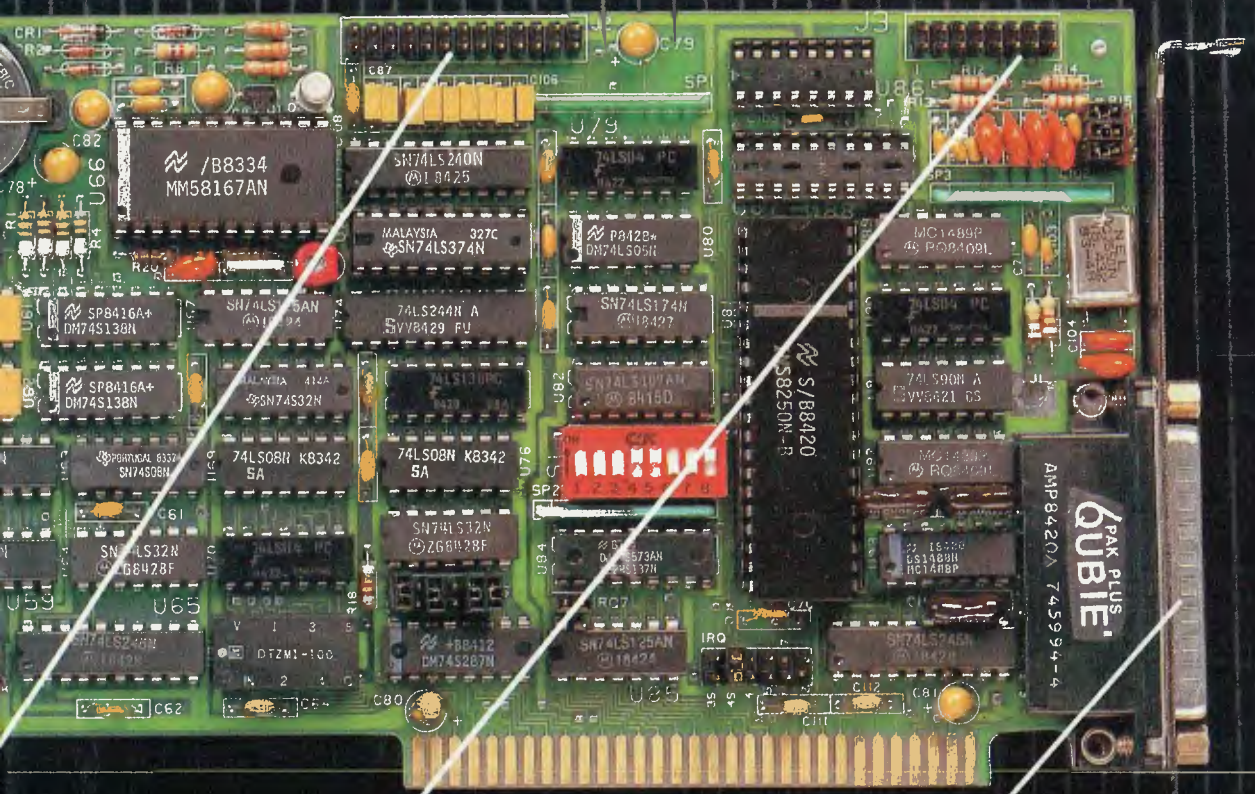

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FEBRUARY, 1986

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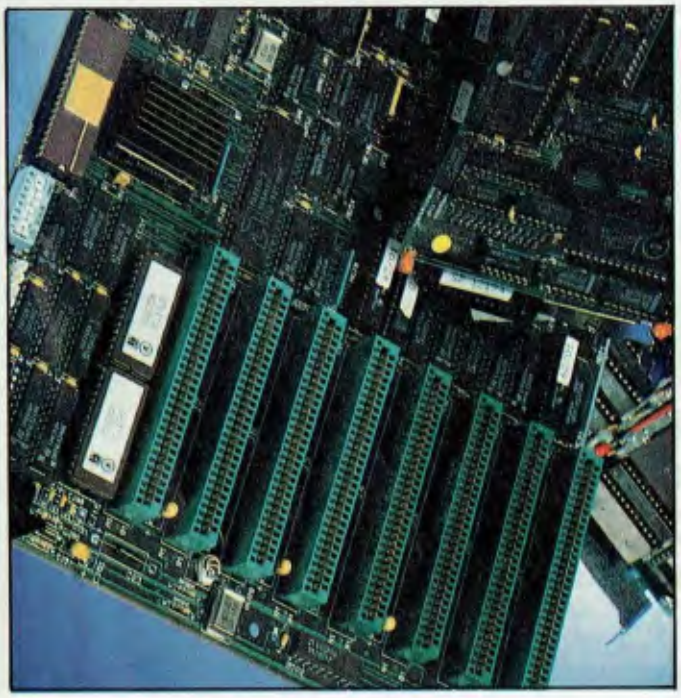
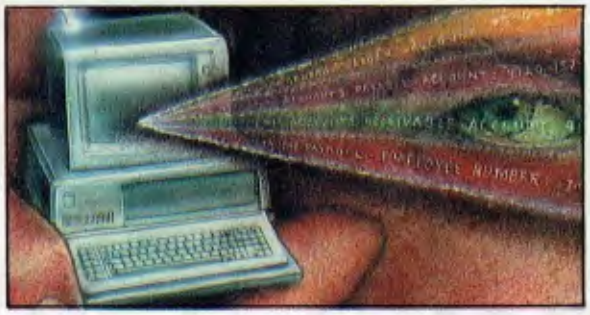
FEATURES





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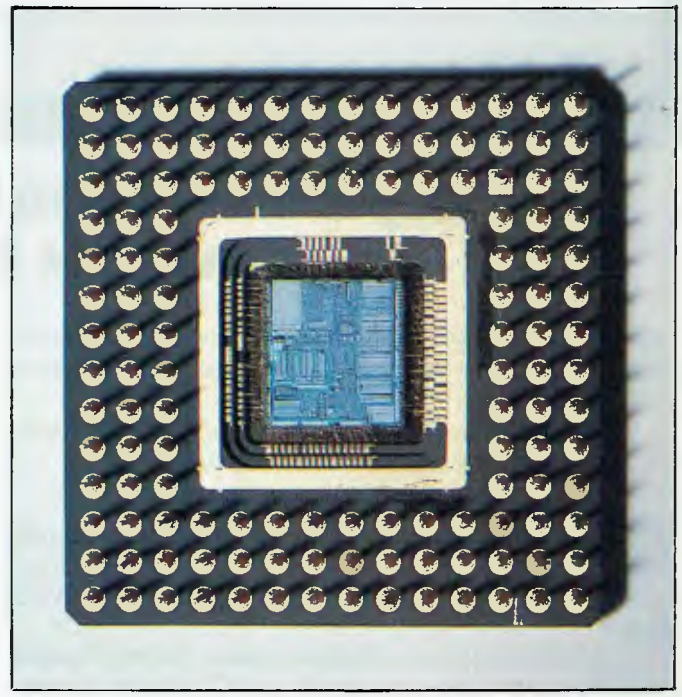

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Amiga offering?

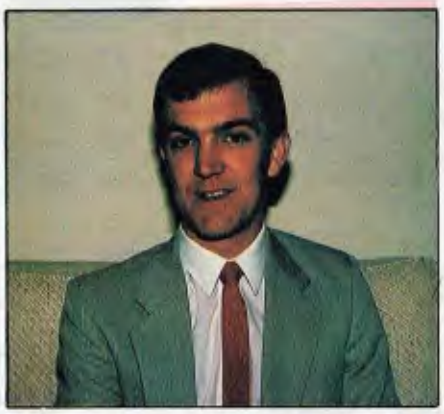
Australian-made hardware products designed, specifically for the IBM PC and compatibles, are finally beginning to give the imports a real run for their money. In recognition of this, PC Australia will now include a regular page, entitled 'First Look', which will be dedicated to reviewing these home-grown offerings.

Judging by the amount of feedback I received in the last few weeks, relating to my previous editorial about the ever-improving PC standard and the potential enhancements offered by the innovative Commodore Amiga, I get the feeling that this particular computer is going to become one of the hot items of 1986.

Unlike the esoteric and egocentric Apple Macintosh, the Amiga was launched with a viable gateway to the serious world of IBM PC standard computing, and therein lies a sound reason for longevity, if not resounding success. Commodore had already shown its support for the PC standard by releasing the highly-compatible PC 10 and PC 20 (XT), despite the fact that its incompatible Commodore 64 had the lion's share in the home computer market for some time.

Hence the Amiga was made available from the outset with IBM PC compatibility as a low-cost ($US99) option, and Lotus 1-2-3 (everbody's favorite benchmark) was demonstrated running on the Amiga at its launch. Unlike the rather bodgy PC emulation methods offered by other non-compatibles, the Amiga solution, known as *Transformer*, is entirely a software implementation.

As it turned out, during the Amiga's development, both hardware and software solutions to PC emulation were studied, before the decision was made to run with the more elegant software approach. Indeed, many of us can still recall the old Z80 plug-in boards that abounded when the IBM PC was first launched, which allowed early users to get useful



work from their old CP/M software while new and wonderful programs such as 1-2-3 were still under development. How many of those would still be in use now?

With true multitasking capability, stunning 640 × 400 pixel graphics, a palette of 4096 colors, compact-disc-quality sound and speech synthesis, all provided in the low cost ($US1795) base model, the Amiga is set to make a sizable dent in the mircocomputer marketplace, simply on its own merits. However, the bonus of PC compatibility gives it that much more clout in the more lucrative and long-term business personal computing market. Rather appropriately, as part of the secrecy surrounding *Transformer's* development, the PC emulation product was code-named 'Trumpcard'.

Transformer is supplied on a single 3.5 inch disk, and once loaded, makes the Amiga appear as a virtual IBM PC at the hardware level. PC-standard 3.5 inch disks can be used in the Amiga's internal drive, or an optional 5.25 inch PC-compatible drive may be attached, While resident, the *Transformer* program interprets each 8088 instruction, calculates the effective address of the operand, and performs the equivalent operation on the Amiga's 68000 CPU.

Companies such as Borland have already announced plans to release vital development software for the Amiga (Pascal, C and assemblers), allowing software developers to easily port across popular PC programs to the Amiga.

Multitasking on the Amiga is helped along by a trio of ingenius coprocessor chips, each dedicated to different elements of the hardware, and all functioning in co-operation with the 68000 master CPU. This parallel processing approach is a great deal cleaner than that used in the Macintosh which, although using the same 68000 CPU, crams all of its functionality into the software rather than the hardware. Comparisons between the two systems dramatically highlight the speed difference.

This leads to the one major disadvantage which the Amiga shares with the Macintosh, namely the dependence on proprietary components, making it very difficult for Amiga clones to appear. Imitation is the sincerest form of flattery, and in the personal computing business, imitation is also a necessary prerequisite to a long and fruitful life, as both the IBM PC and Apple IIe have shown. Have you ever heard of a Macintosh clone?

The success of the IBM PC is due not only to its open architecture approach, but to its use of standard, readily-available components. This removes a great deal of the risk and guesswork from developing compatibles, and therefore establishes a good base on which to build an industry and a standard. If the Amiga is to succeed in the long term, it must be possible for other developers to build compatible systems, and therefore they should have access to the custom Amiga chips at a reasonable price. Provided the powers that be at Commodore recognise this fact, and do not try to hog the entire Amiga market, there is every chance that the Amiga could play an important part in advancing the PC standard, and the state of the art in business computing, to greater heights than ever before. ■

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Courtesy PC Australia

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Home-made chips

In the early days of the automobile, Henry Ford would paint the Model T any color you wanted — as long as it was black. And, until recently, integrated circuits were sold much like the Model T — you could buy any IC you needed as long as it was a standard part already designed and manufactured by a semiconductor company.

But a new age of customised silicon is dawning. It's now feasible for an engineer to design a customised IC that can take the place of a whole collection of off-the-shelf chips. Known as semicustom or application-specific ICs (ASIC), these special-purpose chips cost less than the parts they replace, require less board space, and use less power. And because it's difficult and time-consuming to decipher the details of logic buried in customised chips, proprietary design information can be protected from the voracious board cloners — at least for a few crucial months.

The two names for these ICs originate from how they're produced and used. "Semicustom" means that only part of the chip design is customised with the rest being standard. "Application specific" indicates that the chips contain logic circuitry that meets the requirements of a particular application. Instead of building a board or system using general-purpose ICs connected together on a printed circuit board, some of the logic needed for a given application can be placed in a semicustom chip. For simplicity, I'll refer to both types as semicustom.

Semicustom chips are practical because much of the design and manufacturing is shared by many users, and powerful software can be used to automate many aspects of designing a chip. As you might guess, the software to design, simulate, and test chip designs requires a lot of computing power. Originally, you needed a large mainframe for those programs, but now they run on engineering workstations, and some even work on the AT or the XT.

Semicustom chips include everything from programmable logic devices (PLD) to more complex gate arrays and standard cells. A PLD is an integrated circuit that contains a collection of logic gates, such as the Boolean AND and OR, connected in a standard configuration. A gate array is a regular grid of transistors that can be connected to create the various logic functions needed for a specific design. And a standard cell starts off, tabula rasa, as a blank piece of silicon upon which the engineer places predesigned components.

The design and fabrication costs of a PLD are shared by all buyers. These customers modify the way a PLD's logic gates are wired together by selectively destroying built-in links with pulses of electricity.

Before long it will be practical to program all the logic for an entire board — or even an entire computer — on to one or two chips. But until everything fits on a single chip, the number of input/output pins needed for complex chips is an important limitation. The logic in some of the existing semicustom chip sets for the PC could easily fit on fewer chips; however, there wouldn't be enough pins to get all the signals into the chip and back out again. One semiconductor company already has all the standard cells needed to reduce the motherboard of the AT to a single chip in addition to the processor, except for one problem — no practical package exists that has the required 250 or so I/O pins.

In addition to the benefits to system designers and end users, semicustom ICs are also good for the semiconductor industry. Advances in IC fabrication have already outstripped traditional methods used to design chips. The number of basic electronic components crammed on a single chip has increased dramatically as technology has improved. The original 8-bit Intel 8080 microprocessor had 4000 transistors; the 16-bit 8088 in the IBM PC has 22,000 transistors; the 80286 in the AT has 128,000 transistors; and the new 80386 32-bit processor has over 275,000 transistors. During the same period, RAM memory capacity increased from 1000 bits per chip to the current standard of 256,000 bits, with 1-megabit chips expected to arrive soon, and 4-megabit chips already in the process of development.

The exceedingly complex chips of tomorrow, with millions of transistors, will be expensive to design and debug. Only a limited number of general-purpose VLSI chips, such as microprocessors and memory, are likely to sell in enough volume to justify their development costs. The solution is simple — have customers design their own semicustom chips. Except for creating a few high-volume parts, IC designers employed by semiconductor companies in the future will develop new standard cells, improve the software used to design new chips, and keep looking for ways to put more transistors on each chip.

And when the software used to design chips becomes even more powerful and easier to use, semicustom chips will someday be designed by people with little, if any, detailed knowledge of the underlying hardware. Just as you can create a template for *1-2-3* without understanding assembly language programming, it will be possible to design a semicustom chip without being an engineer.

When it's as easy to create a semicustom chip as it is to use a library of standard functions in C or Pascal, the dividing line between developing hardware and software will get pretty fuzzy. To paraphrase Andy Warhol, maybe eventually we'll all be hardware designers for 15 minutes. ■

Ron Jeffries is a regular contributor to PC Magazine

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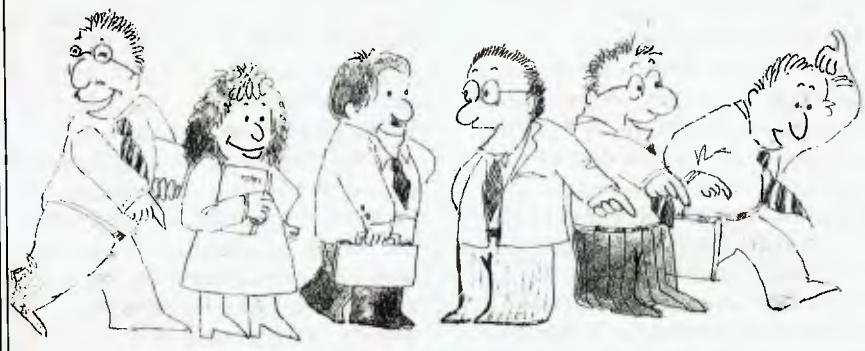

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The LEO AT/PC comes with two floppy disk drives, but is otherwise identical to the LEO AT/XT. In addition to these "standard" features the LEO AT/XT and AT/PC offer enhanced performance unequalled in the PC marketplace. Yet, even with all these advantages, the LEO AT/XT and AT/PC are available at the same price as older, less powerful machines like the IBM® PC/XT and compatibles.

LEO AT/PC/XT SPECIFICATIONS:

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MEMORY: 512KB DRAM standard on board 16 KB ROM: BIOS.	
AUXILIARY STORAGE: AT/XT: floppy disk drive (360 KB) and 1 winchester disk drive (20 MB) AT/PC: 2 floppy disk drive	**POWER SUPPLY:** Higher U.L. power rating than the IBM® PC/XT.
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Feedback continues

Amid the press releases, subscription applications, invitations and junk mail which flood the PC Australia office each week, good old-fashioned 'letters to the editor' pop up from time to time. Here are just a few:

Defending the not-so-slow Samna

Just finished reading the January issue and I thought you might like a little feedback on a couple of items.

The article "Economy of Words" on page 31 found it necessary to once again level the serious charge of "written in BASIC" against poor old *Samna Word III*. *Samna* is not coded in BASIC. I have met the originator and the development team and I've seen the source code. It is in fact written in C. The work is done on a PDP-11 and cross-compiled, and from *Version 3.0*, many time-critical areas have been recoded to native 8088 machine code. Additionally, Samna has always handled keyboard interrupts direct. It will keep up with any fast touch typist. We at Arcom Pacific feel very fatherly towards Samna, so forgive us if we appear overly defensive.

The breakout box on 'resident spellers' on page 35 quotes a price of $US99 for Borland International's Turbo Lightning. Arcom Pacific, Australia's largest distributor of Borland products, has set the retail price at $160.

Finally, in relation to the Extended Memory Board prices shown on page 52, we have dropped the price of the Hyperam board to $995 (excluding tax) or $1058 (tax included) to make the board more cost competitive.

In your Editorial for that issue you mentioned the Lotus/Intel/Microsoft standard. I've noticed that some US companies are rearranging the order of the names to make it 'MIL spec'. How's that for confusion?

May I wish you and PC Australia every success for 1986.

Ronald Chernich
General Manager
Arcom Pacific
Mayne, Qld.

Responding to a threat

In reply to your letter enclosed with PC Australia magazine (with the threat to stop sending the magazine unless I returned the subscription card). The magazine is of value to me for the following reasons:

1. The focus on the IBM PC and compatible machines and associated products.
2. It is a reasonable size. Larger magazines require more searching for interesting items.
3. The articles are of a good standard and cover some of my areas of interest (although data communications has had little coverage to date).
4. Timeliness of information is important, and so far you are better than most.

A helpful feature for the future would be to provide an index to back issues. I spend an unfortunate amount of time trying to track down reviews, new product announcements and even product advertisements.

Please continue the good work.

David Heinrich
Technical Consultant. Simtec
Beverley, SA

Thanks for the feedback David. I'm glad you mentioned an index to back issues, because an online version is gradually taking shape, as those readers who have logged into the PC Australia BBS will know. Option 2 of our videotex BBS is an index to all existing issues, divided into features, PC Essay, Spreadsheet Clinic, User-to-User, The Stein Way, and so on, with summaries and page number references. The complete BBS will soon be transported to Viatel. A printed version may follow. — Ed.

Any back issues left?

Thank you for the January issue of PC Australia. The items (and even the ads) are well presented and interesting, particularly "Downloading Character Fonts" (on page 39). I had long wondered what that involved, but had not thus far found a sensible description of the subject.

I would like to know whether back issues can be provided to unlucky PC users who were not on the distribution list for issue one.

Don Jender
Director — Logistic Policy
Department of Defence
Canberra ACT

Back issues still remain for all issues of PC Australia. If you want a copy, send a note to the Circulation Manager, GPO Box 55A Melbourne 3001, stating the issue(s) required and include $4 for each magazine. — Ed.

Any Symphony templates?

May I congratulate you on a well-balanced and fine publication. The packages we use at the moment are an engineering package called *Microstran* and *Lotus Symphony*. One particular interest would be in articles on *Symphony*, how to make templates and so on, and anything to do with stock control and costing. We have yet to realise the full potential of our PC as all of us here are novices.

Gunter Butters
National Manager — Production
Instant Scaffolds
Artarmon, NSW.

We have an article coming up very soon that you may well be interested in. Diehard PC user Tony Ward has been developing Symphony templates which interact with a videotex package to automatically retrieve the latest market figures, and integrate these into a spreadsheet model. Without giving too much more away, stay tuned for the March issue of PC Australia. — Ed.

R.S.V.P.C.

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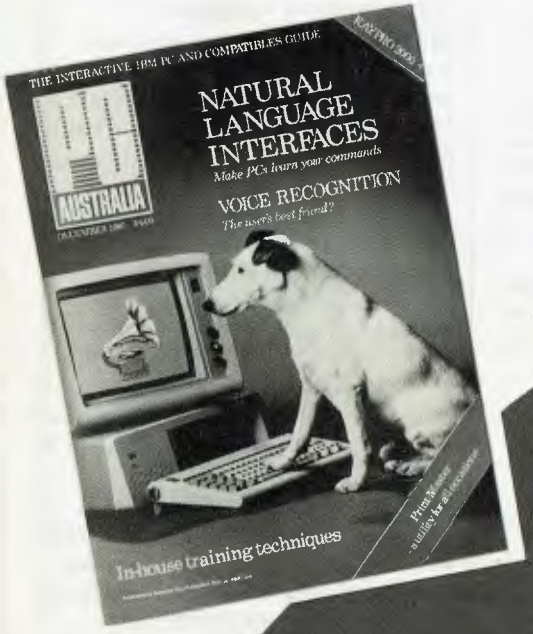


Complete the subscriber card opposite and remember to fill in the serial number of your IBM PC or compatible to qualify for your free subscription to PC Australia.

PC AUSTRALIA News

Windows to open in Australia

After an embarrassing and lengthy postponement (even for today's troubled software industry), Microsoft *Windows* is finally available in Australia. The long-awaited graphics-based operating environment has been released locally by Microsoft for a suggested retail price of $195, and the local version features special modifications for date format and metric measures.

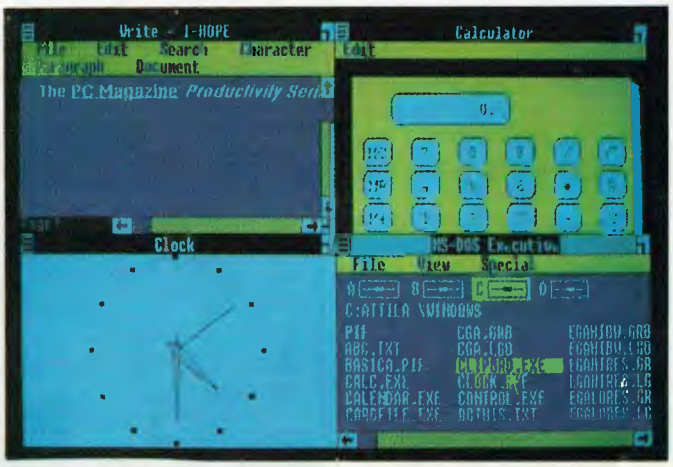
Windows is Microsoft's own version of a 'friendly' iconised operating environment, based on the desktop metaphor popularised by the Apple Lisa and Macintosh. No longer will the world of pull-down menus, scroll bars, icons, dialog boxes and trash cans be the sole domain of Apple users.

Windows allows the PC user to load up several applications (each assigned its own specific 'window' on the screen), and to switch freely between them without having to quit and restart each time. Bundled with the product are Windows Write and Windows Paint, basic applications for writing notes and drawing graphic images. Limited integration is also provided, through the Windows Clipboard feature, which provides for the transfer of text or graphic information between applications.

Since the loading of multiple applications such as Lotus 1-2-3, dBase III, WordStar and so on would quickly fill up memory space, *Windows* has been designed to be compatible with the Lotus-Intel-Microsoft Extended Memory Specification (EMS), allowing the traditional 640K RAM limit to be overcome. Once the available RAM has been filled, *Windows* will locate the most dormant application and swap it to disk.

For those dyed-in-the-wool DOS users who can't get used to the overwhelming friendliness of *Window's* user interface, the package includes a DOS file management facility, with access to all of your old favorites — DIR, COPY, ERASE or FORMAT. Also included are a calendar, cardfile, notepad, calculator, clock, communications utility, as well as the Windows Write and Windows Paint applications.

Windows will operate with the standard IBM Color Graphics Adapter, the Enhanced Graphics Adapter or the Hercules board, and will support the Hewlett-Packard plotters and Laserjet, Epson FX-80 and compatibles plus the new IBM Proprinter. The system can be completely operated from the keyboard, or with the aid of a Microsoft Mouse.



Microsoft Windows: local version features special modifications.

Project gets a revamp

Microsoft Corp. has completely revamped its *Microsoft Project* software, shifting the emphasis to corporate use, company officials say.

Version 2.0 of the project-scheduling and -costing software includes such new features as PERT charts, time increments that range from minutes to months, comparisons of planned versus actual performance, and the ability to handle projects with as many as 999 tasks.

The Australian release of *Microsoft Project 2.0* is scheduled for late February.

PC AUSTRALIA TOP TEN

1.	**1-2-3**	— *Lotus Development Corp.*
2.	**Multimate**	— *Multimate International*
3.	**dBase II**	— *Ashton-Tate*
4.	**dBase III**	— *Ashton-Tate*
5.	**Word Perfect**	— *SSI*
6.	**WordStar**	— *Micropro*
7.	**Word (PC ver.)**	— *Microsoft*
8.	**Open Access**	— *Software Publishing Inter.*
9.	**Attache**	— *Attache Software*
10.	**DisplayWrite**	— *IBM*

The PC Australia Top Ten is derived from monthly surveys of over 240 PC software outlets by Focus Research.

Automatic signature verification by PC

Sydney-based DataSig has announced *Microsig*, an automatic signature verification unit for banks and other financial institutions which links into PCs or compatible systems. The unit allows the owner to digitise customer signatures, store them on disk, and retrieve them quickly at teller stations or other areas where signature identification is required.

The *Microsig* verification units are manufactured by US company Autosig Systems Inc., which also produced compatible high volume batch stations (750-1000 signatures per hour) in addition to the PC-based systems. The *Microsig* package includes a document scanner for digitising hard copy signatures and an Autosig 5300 graphics terminal.

Features of the system include automatic exposure control to adjust for dark or faded signatures, varying document sizes and very high resolution graphics for sharp signature display. Up to four messages can be displayed for each signature, and messages can be entered on an account-wide basis or by individual signature. A multitasking feature allows the Autosig terminal to display signature records at the same time as the PC is being used for other applications, and signature records may be printed by an IBM Graphics Printer or compatible.

DataSig's new unit allows quick verification of signatures.

IBM laptop prototypes

Various prototype models of an IBM laptop PC have been circulating around beta test sites in the US, in order to gain vital user feedback and to determine compatibility levels with popular third-party products. The prototypes include a variety of screens and internal configurations, indicating that a final design has not yet been selected.

However, the often-quoted IBM codename 'Clamshell' now seems quite appropriate because as opposed to current laptop compatibles, the IBM model features hinges on both sides of the unit, so that the keyboard and display screen flip open like a mollusc. IBM is said to refer to the tiny PCs internally as 'travelling executive workstations'.

Most of the laptop prototypes weighed in at about 7 kg, a little on the heavyweight side, but with up to 512K RAM on board and two 720K 3.5" inch disk drives, who would complain? Transfer of programs and data from standard PC systems is accomplished through the use of a simple ribbon cable, which connects to the rear of the disk drive card in the PC. A short expansion card for the AT provides a similar facility.

Other features of the prototypes include long rectangular expansion module 'slices' similar to those available for the PCjr, desktop utilities embedded in ROM, and a small but well-designed keyboard. Screens used include a sharp 25-line LCD and an electroluminescent display (ELD), both of which have received favorable reports.

As would be expected, no official recognition of a laptop PC has been made so far by IBM, although industry analysts claim that it will be vital for the final product to maintain a price point at around $US2000 to expect any long-term commercial success.

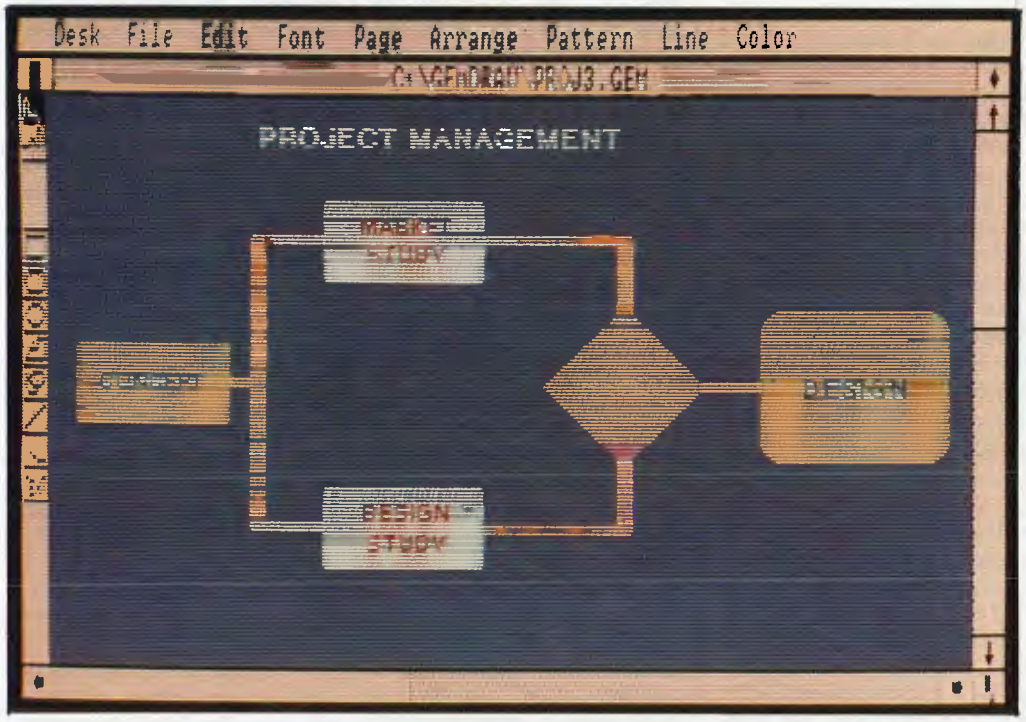
Gem sells 100,000

During its first six months on the market, Digital Research's *GEM* operating environment has sold over 100,000 copies worldwide. Despite the competition provided by similarly targetted products, such as Microsoft's *Windows*, *DesqView* and IBM's own *TopView*, *GEM* has managed to establish itself on both the US and European best-seller charts.

Ron Chernich, manager of Australian *GEM* distributor Arcom Pacific, claims that the demand in the Australian market has been consistently high since its launch at the PC 85 show in Melbourne. Chernich attributes *GEM's* large turnover to the growing popularity of the 'desktop metaphor' and icon-based operating environments among business PC users.

Applications within *GEM* include *GEM Desktop* (incorporating a filer and organiser), GEM *Write*, *GEM Draw*, *GEM Paint* and the *GEM* Collection.

GEM's success has been hampered along the way by several other factors, including a protracted court battle with Apple over the use of the 'desktop metaphor' (which was originally popularised by the Apple Lisa and Macintosh), and the fact that IBM scrapped its decision to promote *GEM* in its US Product Centres. Nevertheless, 100,000 units is a respectable number of sales for any PC software product, particularly under the current market conditions.



GEM Draw: part of an increasingly popular operating environment.

Lotus sells off TK!Solver

Industry analysts claiming that *TK!Solver* would become the flagship product of Lotus Development Corporation's engineering division have been proven wrong, as Lotus recently sold off the rights to the equation-solving software to Universal Technical Systems. Lotus acquired the rights to *TK!Solver* in 1985 as part of the deal in which it bought out *VisiCalc* developer, Software Arts Inc.

It now appears that the Software Arts acquisition was mainly intended to get hold of the human resources of the pioneering software house, because the company's other flagship product, *VisiCalc*, was also scrapped by Lotus. In fact, an exchange offer was made to users of *VisiCalc* on the PC to convert to *1-2-3*.

Co-resident PC Tutorial

Perth company, Intouch Computing, has released the Complete PC Tutorial, a co-resident package which teaches PC-related subjects ranging from DOS instruction, BASIC programming, assembly language and machine code programming, through to hardware-intensive subjects such as screen display and graphics control, speaker and keyboard control, interrupts and function calls.

Richard Swannell, manager of Intouch Computing, claims that a pre-release of the product in November resulted in an overwhelming response and many PC dealers hoped to bundle the product with each new sale.

The product is designed to speed up the PC familiarisation process and thereby reduce the time a sales person must spend to introduce a novice to computing. Negotiations are underway with several US and European distributors for overseas rights, according to Swannell.

Complete PC Tutorial uses a windowing overlay technique, enabling it to run concurrently with existing languages and applications. Like other co-resident utilities, the program intercepts keyboard interrupts and passes on to the application all keystrokes except those with the Control and Shift keys held down, as these invoke the Complete PC Tutorial commands.

The 20 lessons contained within the Complete PC Tutorial are divided into three sections —beginner, programmer and hacker. Over 500K of Tutorial code as well as programming examples are included on the two disks supplied, which are password protected.

Hypertec flys the flag

After finally arriving at the agonising decision as to which of the eight expansion cards currently filling my overcrowded XT was the least indispensable, I reluctantly removed it to make room for my new Hyperam extended memory multifunction board. The Hyperam board, from Sydney-based company Hypertec, is the first local attempt at a multifunction board.

Inserting the board was a smooth and relatively painless operation. Don't laugh — there are several expansion boards on the market (particularly Australian-made products I am ashamed to say) which can be a real pain to install. Manufacturers often brush aside criticisms by claiming that the PC chassis dimensions can vary by several millimetres, but you should take this with a grain of salt. Anyway, the Hyperam slipped into the expansion slot no problems, and was even easy to secure with the mounting screw.

Hypertec obviously intends to be around for a while, if the quality of the Hyperam circuit board is anything to go by. A prototype Hyperam which was demonstrated at its launch late last year included a number of cut tracks and patch wires, but the current production model is as clean as a whistle. The reason for the patch, by the way, was a last-minute change to the now-accepted Lotus/ Intel/ Microsoft Extended Memory Specification (EMS), which had been announced just prior to the Hyperam launch. An executive decision was made to change the circuitry from Hypertec's own bank-swapping configuration to one compatible with the EMS, and a wise move it was, because the EMS is now the undisputed industry standard for extending PC memory past 640K.

Software which has been modified to support EMS includes such heavyweights as *Lotus 1-2-3 Version 2.0*, *Symphony Release 1.1*, *Framework II*, *SuperCalc 3 Release 2.1*, and the *Microsoft Windows* operating environment. With big names such as these, the remainder of the PC software is scurrying to jump on the EMS bandwagon. (A detailed description of extended memory boards and the EMS standard were featured in last month's issue of PC Australia.)

Of these I only had access to *Framework II* at the time of review, but it seemed to operate without any hiccups with the Hyperam board installed. *Framework II* adjusts itself to the memory and disk configuration of the host PC and, once available memory has been exhausted, swaps out lesser-used portions to disk, with as minimal disruption as possible, rather than complaining about the limits of memory. To exhaust the Hyperam would take one helluva spreadsheet.

Like most other extended memory boards (and the new model PC AT), the Hyperam uses the new 256K memory chips, although it still adheres to the wasteful IBM scheme of using a bank of nine chips for each 256K (the extra chip is used for parity checks). Two rows of chips are built into the standard board, giving a minimum size of 512K. The standard board also incorporates a real-time battery-backed clock/calendar chip and, until recently, a single serial port. Arcom Pacific recently decided to remove the first serial port to lower the entry price of the board.

The inclusion of a real-time clock on the Hyperam board seems a bit of a gamble, because this prohibits the addition of further Hyperams, and is one of the reasons that the board cannot be used with the clock-equipped PC AT. In fact the company recommends that if further expansion is required, the user should consider an Intel Above Board! The reason that the PC cannot handle two clock/calendar chips is that they are mapped to identical hardware addresses and would cause the dreaded 'bus contention'. After all, if you looked up on a wall to see two identical clocks, how would you know which one was correct?

It is possible to upgrade the Hyperam to include a second serial port and this has been tackled in an unusual way. As most PC users will know, the back panels of PC expansion boards are just not big enough to fit in two standard 25-pin RS232 sockets. Hyperam has tackled this problem by using a single standard 25-pin socket together with a single 9-pin socket similar to those used for video adapters. This is because many lines in a 25-pin socket are unused, and it turns out that all of the important lines in a standard RS232 serial connection can fit into the smaller 9-pin socket.

Room is available on the Hyperam for five more rows of 256K chips, bringing the potential maximum memory size up to 1792K — almost two megabytes! This is the largest memory capacity I know of for any PC multifunction board, and is a strong argument in favor of the Hyperam. A fully-configured memory board will generally cost you more than if you buy the extra memory chips separately and decide to do it yourself. If you are reasonably confident in your chip-inserting abilities, and can recognise the dents at the top end of the chip, then there is no reason why you couldn't upgrade the board yourself.

Two banks of eight DIP switches on the upper end of the Hyperam allow the user to configure the required start and end addresses of RAM, as well as a memory window address and the status of the serial ports. These are rather awkward to operate, compared to other types of DIP switches commonly used, but since board configuration is usually a 'set once and forget' operation, they are quite adequate. Adding a serial port is simply a matter of inserting an 8250 I/O chip, as both serial sockets are permanently mounted in the standard unit.

Software supplied with the Hyperam includes a pop-up co-resident print spooler which allows the user to add items to the print queue or remove them, and to keep an eye on the printer's progress. As with all multifunction boards, a RAMdisk feature is included, as well as a utility to set the real-time clock/calendar. An interesting addition is the cache memory utility, which provides a large number of buffers to store sectors which are read to or written from a disk.

The Hyperam documentation is supplied in a loose-leaf format compatible with the IBM PC documentation, so that it will easily slip into the back of the Diagnostics Manual. The layout and style is also compatible with the IBM format. All features of the board and software are well explained, and a 'conceptual overview' makes things quite clear to the user. A bonus is a final chapter on 'tuning' your PC for faster and more efficient operation.

All in all, a fine job for a locally-made product, and it is a pity that the local electronics industry has taken so long to really latch on to IBM PC standard and the potential offered by expansion boards. After all, that is what open architecture is all about. I look forward to future releases from Hypertec, which are claimed to include an accelerator board and a network board. ■

Hyperam board $1058

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Sperry PC HT

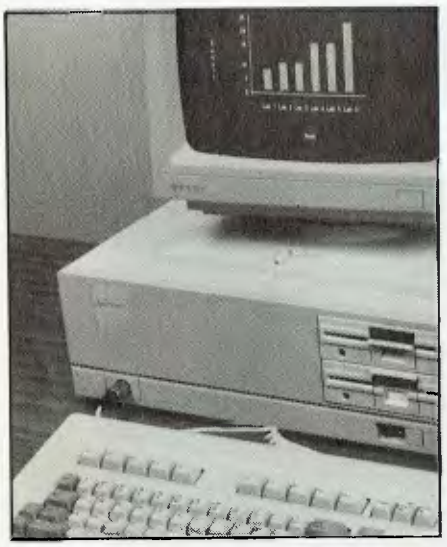
Sperry's HT is a PC compatible with overdrive. Yes, it does feature a high degree of compatibility — but it also offers switch-selectable enhancements for speed and graphics resolution. It is an elegant alternative to the current spate of 'me-too'-ism. Although not a new machine by any means, (in fact, it was released in Australia in late 1984), Sperry's PC so impressed Queensland's educational authorities that they ordered several thousand units for school.

The machine being reviewed was a cut above the standard 256K with two floppy drives. This one had one floppy, 640K of RAM, a 20M hard disk and high-resolution RGB monitor. The drives, like most of the other components, are manufactured by Mitsubishi.

Powered by an Intel 8088-2, it can run at either the regular 4.77 MHz (IBM PC speed) or at 8 MHz. The 'gear change' switch is conveniently located on the rear of the unit. Microsoft's Flight Simulator runs well at either speed, although its frame refreshes are much smoother at 8 MHz. Surprisingly, the simulator still covers the same amount of territory in a given time, irrespective of the clock speed. That's one clever program, and a standard test for PC compatibility.

When first powered up, my initial reaction to the Sperry was "Oh, no! — another incompatible compatible". The screen was just too good to be true. The white characters were twice as sharp as those generated by a normal IBM PC color graphics adapter, and there is a palette of 16 colors.

Screen resolution and serial port compatibility may be set to IBM PC standards by flipping another DIP switch on the rear of the machine. But I decided to check the claim that most PC programs will run in 'Sperry mode'. Most of those I tried did indeed perform. One exception was Sidekick — in high resolution mode it shows only the top half of each character, leaving the PC in that state thereafter. No problems though if



used in normal resolution. A number of public domain utilities also fell over in Sperry mode, although programs with well-behaved graphics (such as Open Access and Stylus) are fine, and the graphics are very sharp.

Inside the box

The system unit is not small, measuring 46 by 42 by 14cm. The RGB monitor has a simple adjustable tilt bar beneath it and carries a single external control for brightness. The screen blanks out after the keyboard has not been used for a few minutes, and the duration may be set by a simple utility. The interior of the system unit is an engineer's delight — solidly constructed with ample room for air circulation. There are six long PC expansion slots, two of which contain a pair of color graphics cards linked at the top by a 61-way flat cable. These provide 128K of video RAM and circuitry for the special color graphics. The nine-pin RGB connector is definitely not IBM compatible, and the composite color output was not tested.

Another slot is taken up with a short 128K expansion card, and a fourth slot contains the disk controller. That leaves two slots free in a machine which has nearly all you need. A small daughterboard attached to the main system board provides another 256K. The price for this board is quite high, but there is nothing to prevent the astute user purchasing a third party RAM board with 384K for a fraction of the cost. The main system board sports one parallel port although, surprisingly, there was no serial card in the review unit. Many users would see this as a serious omission, although correctable, at the cost of one of the two remaining slots.

The video RAM provides one nybble (four bits) per pixel for a maximum resolution of 640 by 400 pixels. Each nybble defines the pixel color according to a palette of 256 possible colors. The screen has high persistence phosphors, and the effect is rather peculiar when scrolling normal white text; the green fades slowest and leaves an eerie trail. Sperry's version of GW-BASIC has been enhanced to support the various screen modes and color range.

The separate keyboard looks very much like the Keytronics OEM unit. It sports illuminated LEDs on the CapsLock and NumLock keys, and a welcome extra Enter key just below the numeric keypad plus key. This is a nice keyboard, with a solid feel and audible feedback from the system unit speaker. It is interchangeable with the standard PC keyboard.

Three manuals arrived with the review unit — an operating guide for the enhanced system, a guide to DOS, and one on programming in BASIC. All are packed in slip-cases in the familiar IBM style. The printing is excellent, with no traces of Jinglish, and the documentation is well-written and comprehensive. A separate technical manual is also available for specialist applications.

Marketing and support

Sperry is presently tooling up for assembly in Queensland, and local production is expected to commence early this year. At the moment, all machines are currently being manufactured by Mitsubishi in Japan. The Queensland plant is not just another 'golden screwdriver' operation, as the intention is to utilise local printed circuit board manufacturers. Sperry has an extensive existing market place amongst its mainframe users, although there is a gradual development of indirect dealerships. At present, the dealer network is responsible for about 20 per cent of all sales.

The Sperry HT is sold with a normal 90 day extendable warranty. Sperry provides maintenance services in all major capital cities. Although the regular retail price is not low, it is better than that of the 'Real Thing'. More importantly, Sperry has offered exceptionally good deals for large contract purchasers such as the various education departments. ■

SPERRY HT

Australian Distributor
Sperry Ltd —
Information Systems Group
100 Miller Street
North Sydney 2060

Basic Configuration

Processor:	8088-2
Clock Speed:	8 or 4.77 MHz
Minimum RAM:	256K
Maximum RAM:	640K
Ports:	1 Parallel
Video outputs:	RGB or composite
Operating System:	MS-DOS 2.11
RRP (inc. tax):	Model 100 (single floppy, mono) $4100
	Model 500 (single floppy, 20M hard disk, RGB) $8983
	256K daughterboard $697

Benchmark Speeds (IBM-PC = 10)

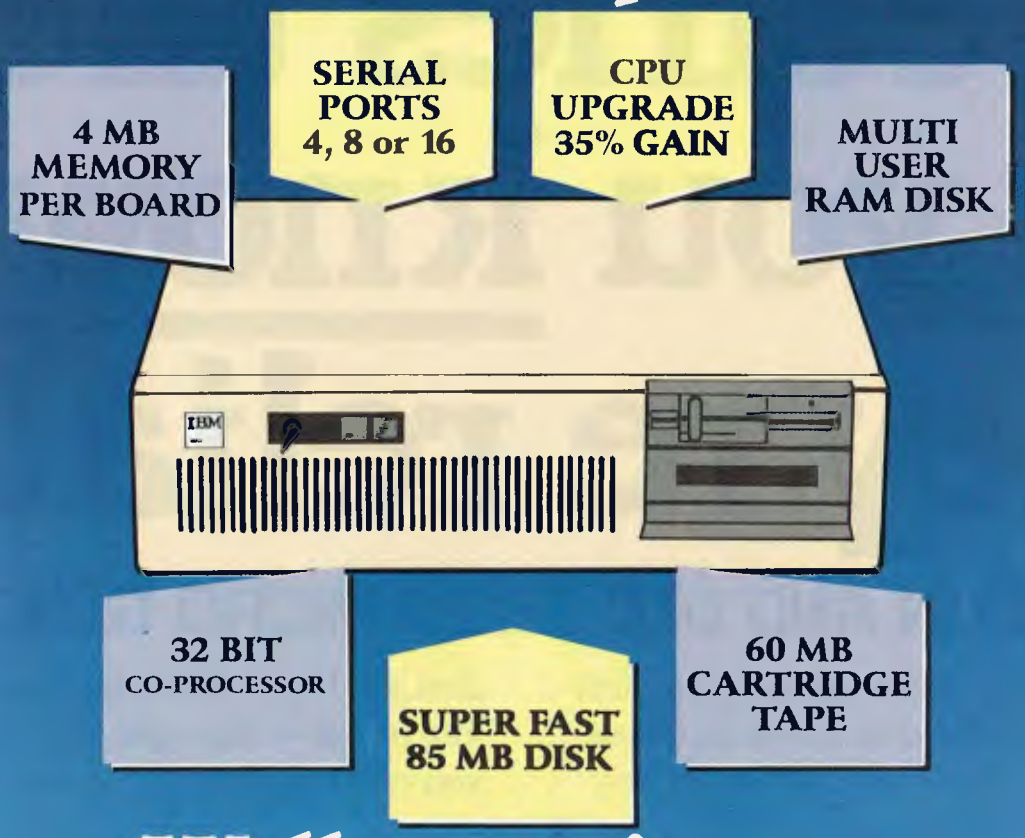
	4.77 MHz	8 MHz
CPU-bound	10	14.6
Disk-bound	8.6	9.5

Ratings 0 (Real Bad) to 5 (Excellent)

Hardware Compatibility:	4.0
Software Compatibility:	4.0
Value for money:	4.0
Documentation:	4.5
Vendor Support:	5.0
Maintainability:	4.5

Best points: Screen quality, speed.
Minor gripes: No series port or external reset.

Isn't it time your IBM PC had these options?



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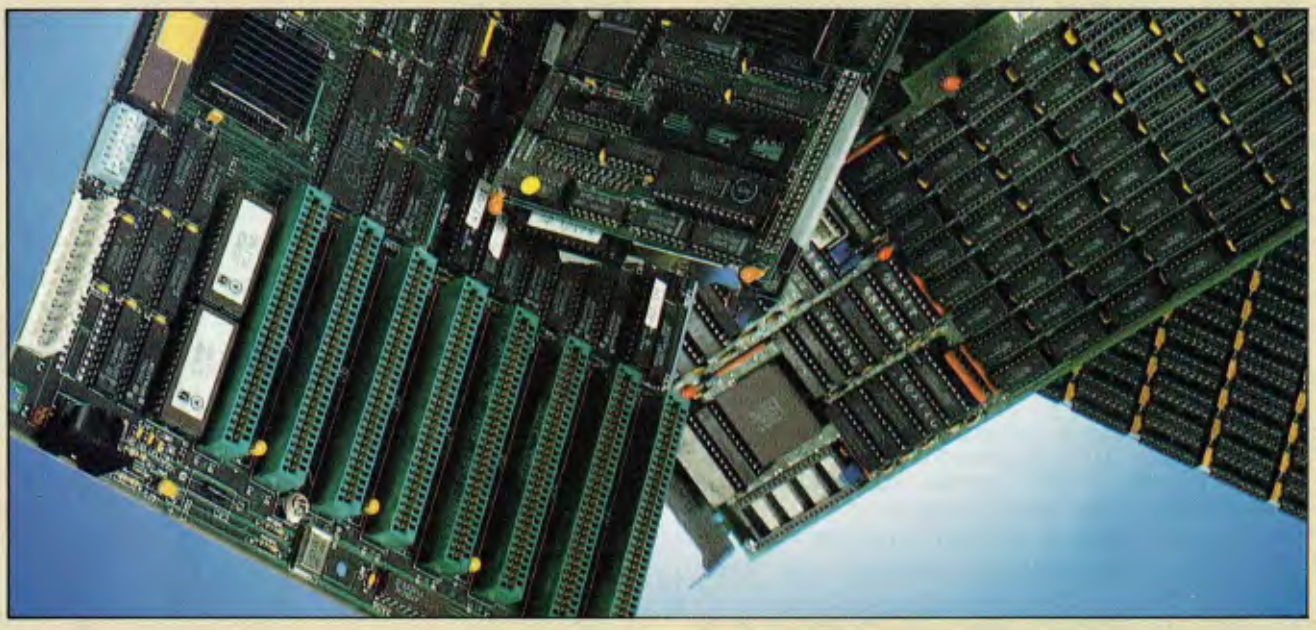
The release of faster PC compatibles with more powerful processors has caused envious PC owners to look at accelerator (or turbo) boards. Winn Rosch presents an overview.



After you have exhausted the mass-storage alternatives for speeding up your personal computer, the turbo board is the next logical step for getting more from your PC investment. Accelerator boards are add-in expansion boards designed to double and redouble the performance of a standard PC or XT.

They certainly sound alluring, particularly to PC users who have had a taste of high-performance computing on an AT. Turbos do, in fact, work the miracles their advertisements claim, but your computing needs — more than any product's innate abilities — determine whether adding a turbo to your system will be a delight or disappointment.

The premise behind the turbo board is hardly profound: The fundamental limit on the "thinking" speed of any personal computer is its microprocessor brain. In the case of the IBM PC and XT, the microprocessor is an Intel 8088 operating at a clock speed of 4.77 MHz.

When the PC was introduced four years ago, that combination put the machine's performance on a par with its leading buisness microcomputer competition, CP/M operating system-based machines with Zilog Z-80 microprocessors that operated at 2 to 4MHz. The PC's extended addressing range of one full megabyte, however, gave it the edge it needed in big-business applications to become the desktop standard. (The Z-80 can only directly address 64K of memory.)

Times have changed, but the PC is not now fundamentally different from when it was conceived. Compared with the latest high-performance personal computers that calculate five or more times faster, it is a lackadaisical performer indeed. Your personal computer represents a substantial investment, however, so tossing it out in favor of a more powerful machine probably is not an appealing idea.

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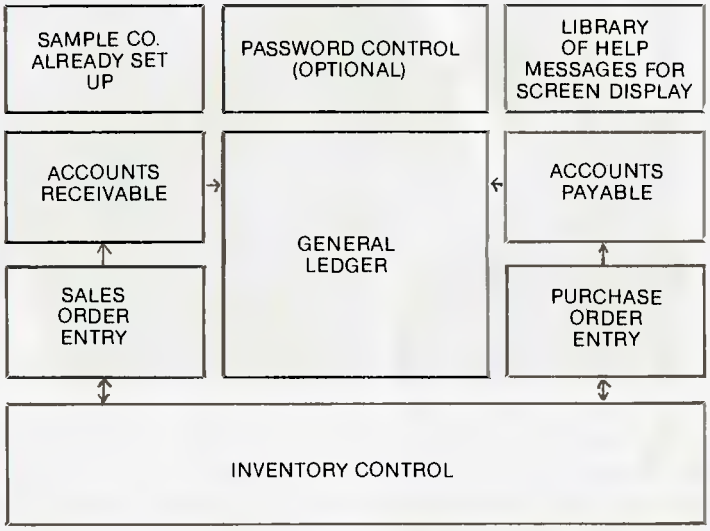

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more from the present system. From that viewpoint, a turbo board can be an excellent investment.

Not everyone needs the increased processor speed of a turbo board, however. If your system relies on floppy-disk drives for its mass storage, the power of the accelerator board will likely be wasted. That's because turbo boards do nothing to make floppy-disk drives work faster. Since turbos merely take over the 8-bit data bus your PC already uses for communicating with its disk drives, their 16-bit power is largely useless. While an accelerator-enhanced computer can fly through calculations, the floppy-disk drive can't keep pace, so the performance boost given by the turbo won't even approach the makers' claims or the board's genuine abilities.

Although some accelerator boards include software to buffer bigger blocks of data read from floppies and thus make them seem faster, adding a hard disk to your floppies-only system — which will truly speed disk access — is often a greater productivity booster than adding a turbo board.

Further, if the programs you run are input/output-intensive rather than calculation-intensive, a faster hard disk — one with an average access time of less than 40 milliseconds — may speed your system's performance more than any accelerator.

Database programs are notoriously disk-intensive. Even a spreadsheet can be an intensive disk user if you constantly shift between many small models that you keep stored on disk rather than analyze everything at once on a single sheet.

Most turbo manufacturers have adopted one of two strategies to adapt high-powered microprocessors to PC systems. Some remove the PC's native 8088 microprocessor and replace it with an entire board — a connector the size of the original microprocessor that leads to a cable connecting the board into the system. Others design the add-in board to work in conjunction with the PC's own processor, which remains in its system-board socket.

Neither strategy is superior for all purposes. Although the hardware of the systems that work in tandem with your present microprocessor is easier to install because you don't have to deal at chip level, it requires running software (sometimes complex) to configure the system. Although microprocessor-replacement systems require you to handle your system's microprocessor, they are relatively clean when it comes to their software needs. After such systems are properly installed, they usually do not require that special programs be run for their daily operation.

Tandem-type systems can claim a singular advantage. Because the PC's native microprocessor remains inside the system, you can switch your veteran 8088 back to its old duties, even after the accelerator is installed, and render your system compatible with programs that might be "choked up" by a turbo.

Most accelerator products claim universal software compatibility, however, and if those claims are true, this supposed advantage of the tandem systems is essentially meaningless. In fact, testing revealed that many new turbos have hidden bugs that can cause programs to crash. (For example, an early version of Pfaster-286 from Phoenix would not run *dBASE II*, and an early version of Kamerman Labs' PC-Superflight would not run *1-2-3*.) As

manufacturers discover such bugs, however, they are quick to work them out, and the products are coming closer to universal software compatibility by the day.

The tandem-type board's use of the PC's own microprocessor for input/output processing at first seems like a good idea. Practically, however, any performance gain from putting the host PC's 8088 to work is not very meaningful.

One reason is that all input/output operations in the tandem systems must go through two systems, taking up some processing time in each one. Another is that even the plain PC has its own tandem processor called a DMA (direct-memory access) controller, which essentially relieves the PC's microprocessor of the need to deal with the nitty-gritty and time-consuming aspects of controlling most disk input and output operations.

Tandem systems do have an advantage over some microprocessor-replacement systems: They use their own, on-board memory rather than the RAM chips inside the system. Although those extra on-board accelerator memories may add to the cost of the boards, the additional chips can give the tandem turbos a two-fold speed advantage by increasing the width of the data bus.

While adding an expansion board cannot alter a PC's internal 8-bit-wide data bus (used to access RAM, among other things), tandem turbo boards have their own on-board data buses that are, in general, twice as wide at 16 bits. Double-width data buses let tandem boards move information twice rapidly as the PC can.

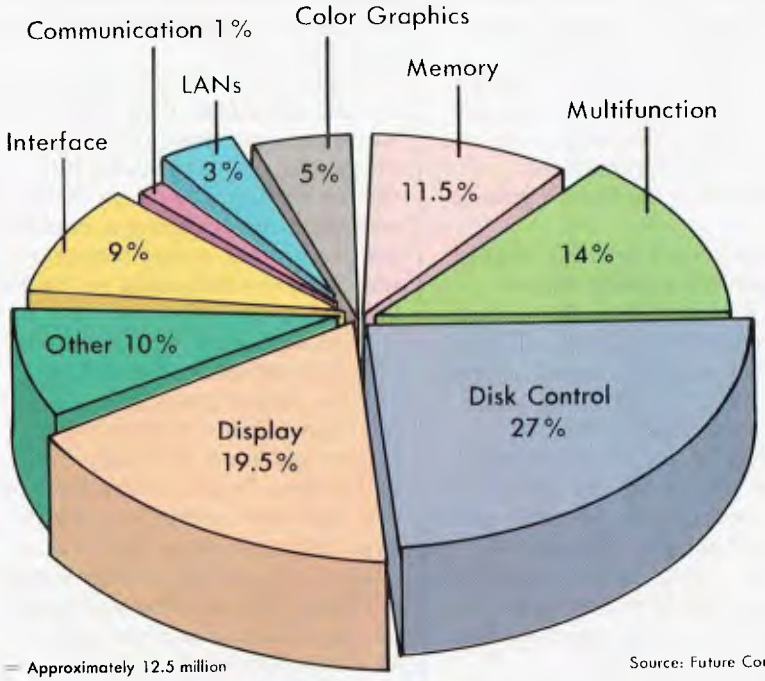
Since such accelerator systems have their own microprocessors and memories, they become the equivalent of a separate, high-powered computer inside the PC, ready to take control at your command.

Microprocessor-replacement systems often work around the 8-bit-bus handicap with their own high-speed, 16-bit memory-cache systems. Essentially, these systems store a small block of data or program code, including the bytes that are most likely to be needed next. Instead of waiting for data from the slow PC bus, replacement processors can plow through local memory as rapidly as it can "think".

Either system, processor-replacement or tandem, when properly implemented, can be effective in boosting your system's microprocessor throughput and, hence, your own productivity. ■

Market Share

Although they have been on the market for over a year, PC accelerator boards are still regarded as a luxury item, as shown by this expansion board sales breakdown, compiled recently by Future Research in the US.



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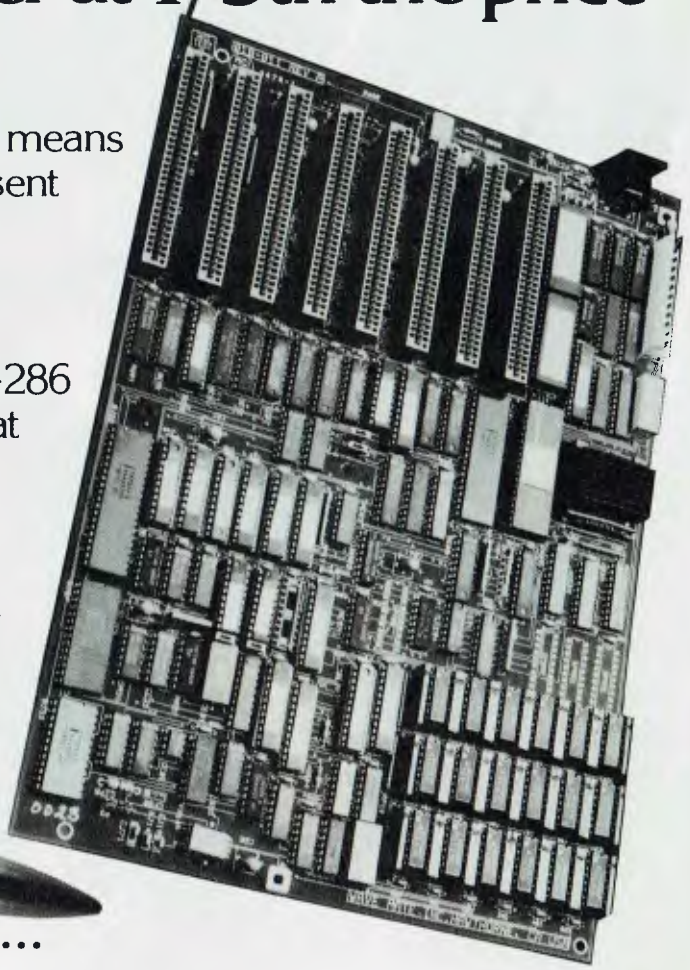

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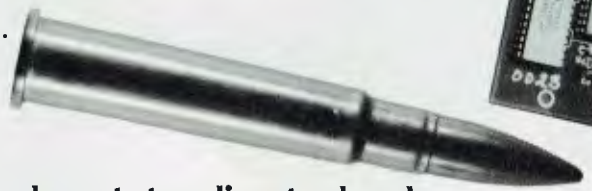

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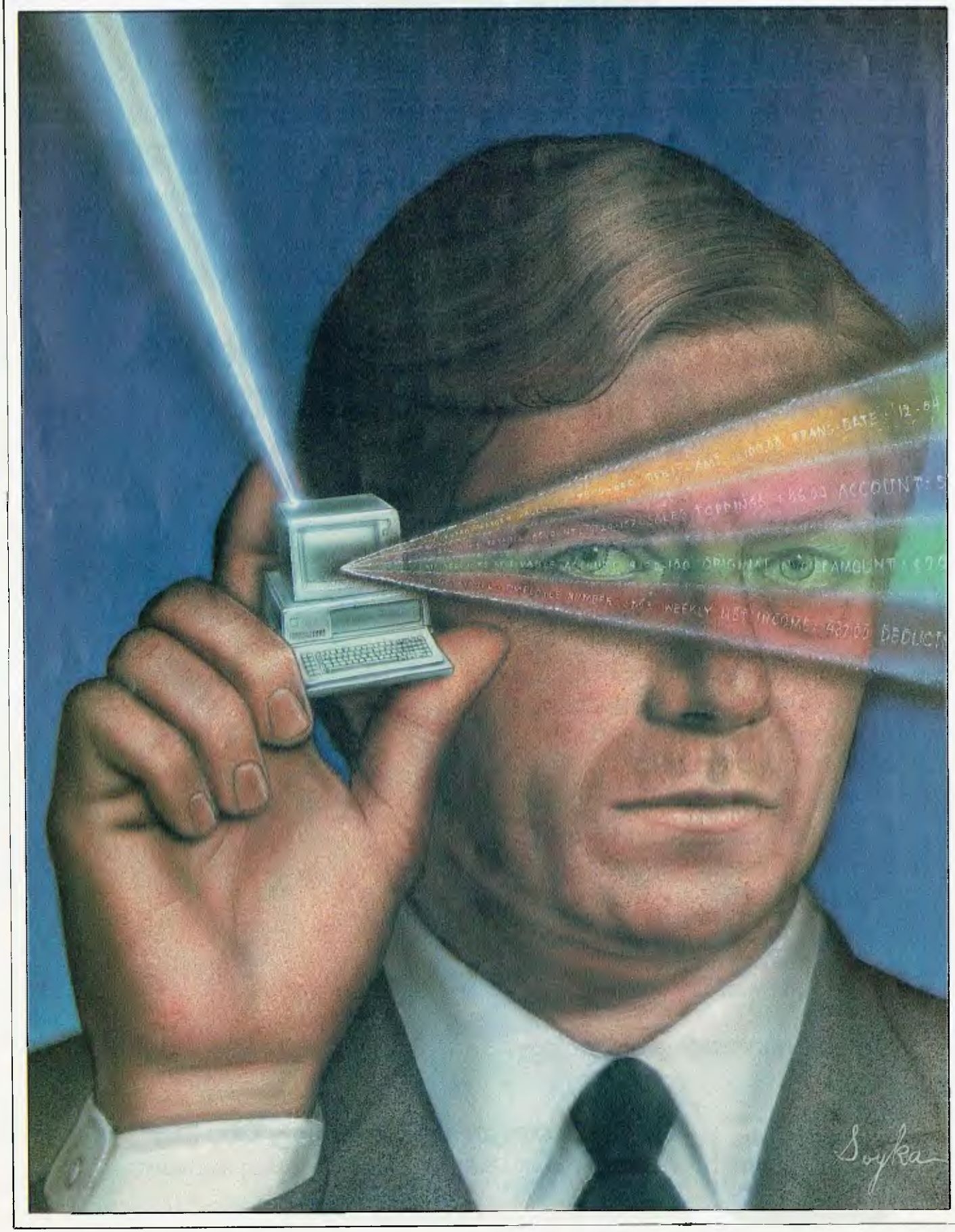
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Knowledgeman/2 -the sequel

Many PC software developers have released their own version of 'the ultimate powerhouse database' with varying degrees of success. The latest contender for the heavyweight crown is a revamped revitalised release of Knowledgeman. Les Stein reports.

I must confess to a recurring nightmare, in which I am being forced to work on a new version of Knowledgeman. This program is so bubbling over with features, so thorough and error-free, that I believe the Knowledgeman programming team must be bolted to their PCs and mercilessly tortured to squeeze more work from them.

Micro Data Base Systems, creator of Knowledgeman, is no newcomer to seminal programming efforts. Its major work, MDBS III, was released in 1982 and is still going strong. This contains an incredible pastiche of database management tools that are invoked by high level language calls (or from within Knowledgeman). MDBS III is also the only system for PCs allowing complex "network" relationships between disparate data in different files.

Knowledgeman/2 is a powerful subset of MDBS III, in a self-contained package which does not need to be manipulated by an external language. It does not permit the network relationships of MDBS III, but instead uses a less complex hierarchical structure where the data in one file is viewed as a subset of data in another. Setting up a Knowledgeman database takes a solid commitment of time and planning, but you are rewarded by a speed and efficiency not found in other, more limited, database management programs.

Knowledgeman is not conceptually novel, as are some of the newer database management systems (DBMS) such as Paradox, Infoscope or Nutshell. It uses a basic DBMS structure and contains standard components to create files, a query language to interrogate them, screen I/O devices to view them and a procedural language to design customised applications. As well, it has a built-in spreadsheet. Within each function is a vast myriad of other devices which make the program (in the right hands) extremely flexible and powerful.

Knowledgeman/2 is really just an upgrade of Knowledgeman Version 1.07 (Box 1 lists the major improvements). The most dominant addition is a menu interface encompassing every function (Box, P. 37) The menus will give an old user a new confidence, as Knowledgeman is one of those products where there is always an element of doubt as to whether you have cranked it up to full potential. A novice user could now wander around Knowledgeman's innards without getting lost, as comprehensive context-sensitive help screens have been incorporated.

This most definitely is not a program for a novice or a casual DBMS user. It is a system designed for experienced application programmers and it would be a case of overkill if it were bought and used

for a singular or minor database. There are so many nuances and subtleties that the novice would probably do better wrestling with a Sumo than with Knowledgeman.

Gaining knowledge

The Knowledgeman manual assumes a comprehensive understanding of DBMS tools. Knowledgeman/2 uses the same turgid documentation as previous versions with the addition of a fat new user's guide to the improved menu interface. This helps, somewhat, in getting to know the program but once again, for the novice, ploughing through the manual is like learning to swim by being dumped in the middle of the ocean.

Each page of the Reference Manual has a different thickness line at the margin to indicate that the material presented is either for the intermediate or advanced user. Only a small amount is without any margin line, indicating that it is for the new user. A discussion of the heart of the program — multiple file queries using "many to one" relationships, takes up only two of the manual's 300 pages — neither of which are marked for the novice.

A separate book "Discovering Knowledgeman", written by Micro Data Base Systems, takes you hither and thither through 100 lessons, and would take about 20 concentrated hours to complete. It is so full of rules within rules, and exceptions to rules, that at the end of the book, Goethe's comments came to mind: "Poor fool, with all that sweated lore I stand no wiser than I was before."

Consistent with the irrepressible Micro Data Base Systems' thoroughness, there are more than 6300 lines of help divided up into 380 screens. By typing "HELP" you can begin a wander through a labyrinth of information screens which summarise and illustrate Knowledgeman commands. Help is available directly for any command, as in "HELP PRINT". The help screens are convenient, but are often so distended that the manual becomes a place of refuge.

The only way to learn Knowledgeman is to plough through the manual page by page, experiment with the program, use the menus and help screens, and then come back to the manual again and again to re-read details and to further experiment, again with much trial and error. Knowledgeman is overladen with intrinsic worth and there is good reason to endure the many hours of learning that it occasions.

It soon becomes apparent in using Knowledgeman that one must make a commitment to it and not dust it off for the occasional job. I would estimate that it would take 40 to 50 solid hours before you realized most of what it could do and were able to use it to design decent application programs. Add another 300 hours to build a turnkey system and it is obvious that your relationship to Knowledgeman must be far more than a brief marriage of convenience.

Knowledge in

After passwords are given, Knowledgeman asks if this is a new session or whether the last should be continued. It then presents its main menu. If you choose to move out of the menu system, Knowledgeman offers a prompt "-", waiting for some action, You can change this prompt to something less enigmatic ("What Next?") by altering what is called an Environmental Variable. There are over 50 of these variables (see a list of 10 in Figure 2) which control many aspects of the Knowledgeman working environment. They are only partially mnemonic (such as E.ICAS for ignoring case distinctions) and are unfortunately set out for your perusal in a single eye-straining table on one page of the manual.

Each database is viewed as a flat file (called a Table) with fields as headings and data stored under each heading as a column. Fields can be set up for strings, for numbers, for logical true/false and any number of virtual fields can be established for calculations. There is no "MEMO" field, as in dBase III.

"Pictures" to control how data will be entered or viewed can be attached to any field. For instance, a phone number would be in the form "ddd-dddd", where "d" forces the entry of a digit. A picture can also be used to change input to upper or lower case and a picture can be set for floating point.

A significant omission is the absence of range checks for numeric fields. A gross check can be made by using a field picture, such as "$ddd.dd" to keep money amounts in the hundreds. This would not, however, prevent entry of amounts less than $100, nor can it distinguish between $100.00 or $900.00, which would, no doubt, be important to the integrity of the data.

Knowledgeman cannot require an operator to verify data by re-entry, nor can the numeric data be checked against some rule (for example, LET INPUT = RATE/3). It is impossible to force data for one field before proceeding with another, nor can the program require a particular character at a specified position, such as for an ID that begins with an A or B. Date calculations are difficult, but possible, as all dates are converted to Julian format.

Knowledgeman lovers may argue that these omissions only exist for the novice. The program has a number of built-in string and numeric functions which can be combined with IF-THEN statements in the

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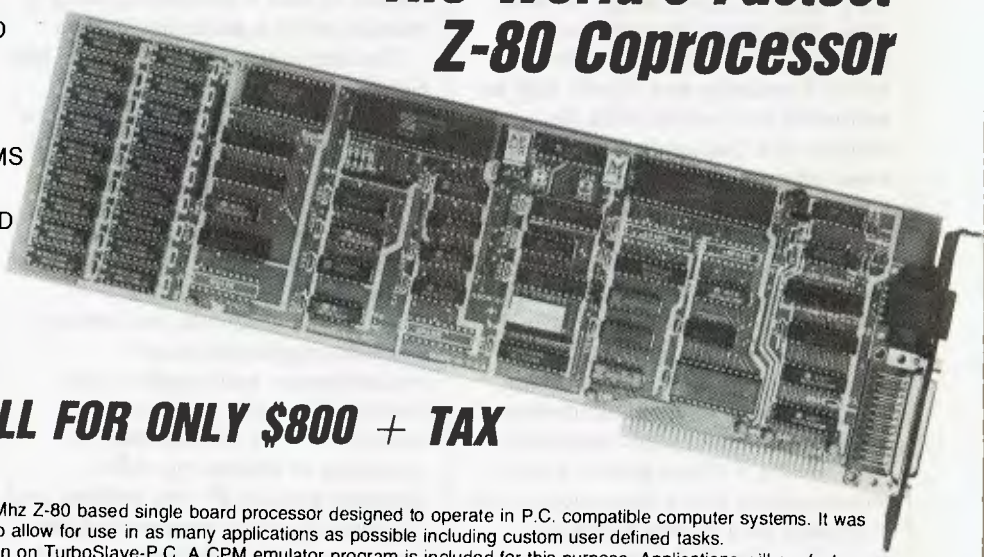

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procedural language to produce data entry checking. The process would clearly be much easier if these data entry checks were Knowledgeman features. They are not outside the realm of what can be expected in a DBMS; they are found, for example, in the ageing DataStar.

Unless the optional screen design program KPAINT is used (see P. 38), the process of screen design for data entry forms is similar to dBase II. However, line by line screen design within Knowledgeman should only be performed by someone with the patience of a diamond cutter. No menu help here. One mistake requires abandoning the form and starting anew. The screen can be enhanced with color and monochrome attributes, but Knowledgeman has no direct method of using single or double lines and boxes, which substantially curtails design options.

Within the devices to manipulate screens, there is a unique command called TALLY which gathers numeric values entered into a form and returns a dynamic sum as new numbers are entered or changed. As the manual states, this allows the use of "what if" analyses on a data entry form similar to the matrix-oriented spreadsheet.

Commanding knowledge

All commands in Knowledgeman have a specific syntax, which turns out to be straightforward and logical. However, commands can be complex, as in this typical command line used to examine certain records for editing and some fields for display: BROWSE TABLENAME FOR LASTNAME <"M" AND RATE>50.00 WITH LASTNAME,RATE.

Long commands such as this can be problematic because the syntax is unforgiving. A single mistake draws a cryptic error message, such as "Expression encountered;FOR expected". In previous versions the command line could not be edited, only retyped. At least Knowledgeman/2 allows the last command to be recalled for editing and re-execution.

The command CREATE RECORDS FOR TABLENAME WITH FORM displays a previously designed form ready for data. With a few variations, cursor control within the form is similar to WordStar. Function keys can be marshalled for data entry or for commands, by use of a separate utility called KEYMAN. An excellent feature is that any key combination can be temporarily defined to hold a command, string or calculation for a particular session.

The data entry functions have a few deficiencies. By changing the Environmental Variable E.LMOD to TRUE, the fields of each new record will be filled by the last entries. However, this cannot be used selectively for only one field, which makes continued insertion of a date or a department a messy affair.

After data is entered, the sorting and indexing functions are comprehensive and simple to use. Sorting of records can be on any number of fields at once, each in ascending or descending order. Indexing uses the B+ tree method, and can also be on any number of fields at once, using or ignoring case, and on any number of characters in the key fields. The manual suggests that index keys be confined to 10 characters for "fastest processing". Any table can be used with as many indexes as are created and these indexes (unless otherwise specified) are automatically updated with each new data entry.

Knowledge out

Knowledgeman uses the SQL query language, which is quite deceptive in its simplicity. It appears very logical, as in SELECT FROM TABLENAME LASTNAME, RATE ORDER BY AZ LASTNAME. However, it is inflexible in its syntax, and errors in a long multiple file query may yield a can of worms.

Multiple or single databases can be searched for a particular record by its number or position (OBTAIN NEXT,PRIOR) or because it fulfills a condition. The SELECT or LIST command will display a list of records that fulfil search conditions. The results of the search can be sorted in any direction on any field, and displayed according to field pictures, with titles and adjusted line and column spacing. A third method makes use of an index or indexes specified and will PLUCK a particular record or set of records that meet search criteria.

Knowledgeman has two sophisticated expressions which are useful in delineating search criteria. The expression "IN", as in LASTNAME IN [JONES,SMITH, BROWN] is used for inclusion of multiple conditions. The "XOR" conditional operator will evaluate two expressions (LASTNAME="JONES" XOR RATE>50.00) and find records that match either condition, but not both. Nothing is missing from the range of Knowledgeman expressions except perhaps the ability to OBTAIN or PLUCK the HIGHEST (highest key value) or LOWEST record.

Unlimited macro structures can be set up which eliminate repetition of long search commands. The menu system, under the heading of "Customised Vocabulary" allows any word in Knowledgeman, or a group of fields, to be given a new description. This is a mini natural language system which, when combined with macros, can smooth difficult commands.

Statistics can be displayed after the results of a search or separately. Any or all of seven statistics on numeric data can be used which, as in Lotus 1-2-3, consist of minimum, maximum,

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CIA 500

*256 KB RAM Model

DEALER ENQUIRIES WELCOME

sum, mean, standard deviation and deviance. Statistics can be acquired across many files and be based on any manner of selection criteria.

It is unfortunate that other basic statistical functions are not provided such as chi-square fit, standard error or mean, range, skewness, kurtosis and frequency distribution. Knowledgeman is particularly suited to more sophisticated statistical analysis as it allows "grouping by breaks", where a controlled break will be performed whenever the value of a field changes. As well, statistics can be generated on virtual fields, and temporary variables can be set up which would allow creation of new variables as algebraic functions of existing ones.

A gaping wound in the Knowledgeman package is the absence of an integral report-writing function. Users must instead purchase an extra module known as K-Report. Within the basic package, reports are sent to the printer by defining a form, using SELECT to extract the relevant data and re-routing the results from the console to the printer by use of the PRINT FORM command.

The behavior of the printer is controlled by Environmental Variables such as E.PDEP (printer page depth) and E.PMAR (left margin setting). Experienced Knowledgeman programmers tell me that it takes about four attempts to get one report looking good. There are no printer drivers provided and therefore superscripts, subscripts, underlining and simple enhancements are not available.

Procedural language

As with all sophisticated DBMS, Knowledgeman comes alive with its procedural language. The language is missing FOR-NEXT and REPEAT-UNTIL although the new version has added a WHILE-DO. There is also no provision made for linking assembly language routines. It is not possible to

create functions and call them by an assigned name as in a high level language such as C or Pascal. For any sophisticated work, convoluted methods must be used, such as defining long macros or nesting files, each of which contains a specific procedure.

After a youth misspent on dBase II, it is nice to have unlimited active variables and one or two (but not three) dimensional arrays. There is also the convenient feature of attaching a variable directly to a command. For instance, if a user were asked what field to list and the answer was put into the variable "reply", the command can be issued SELECT reply.

Last but not least

The Knowledgeman spreadsheet is no competitor for Lotus 1-2-3, nor is it as friendly. It provides an unspectacular 255 rows and 255 columns. What separates it from other spreadsheets is the direct connection to the power and procedures of a mighty DBMS. A multitude of databases can be searched according to complex criteria and the data displayed in minutes in the spreadsheet, the numbers manipulated and the results restored in the databases.

Knowledgeman allows the full use of the procedural language and environmental variables within the spreadsheet. A single cell can call in complex WHILE-DO procedures and move the results to another procedure or the database. Lotus users will appreciate the ability to change the visual appearance of the spreadsheet including the use of color anywhere on the screen, the removal of borders and variation of style of a particular cell. A cell, for example, can be made to turn red when a balance is negative.

Features common to other spreadsheets, such as the placement of negative numbers in brackets, or the changing of comma placement, are possible — after much fiddling with Knowledgeman procedures. The spreadsheet should therefore not be seen as an off-the-shelf program; Knowledgeman is primarily a database with a spreadsheet attached or a programmable database and spreadsheet system.

Knowledgeman/2 is presented by Micro Data Base Systems as a clear alternative to the dBase II variety of database management systems. Knowledgeman goes further and contains more features than any existing DBMS available. Compared with Knowledgeman, dBase III should be consigned to dBasemant.

With the exception of KPAINT, the program is a magnificent example of the capacity of programmers to logically perfect a system. As I see it, if you do serious database programming, Knowledgeman/2 is the only choice.

Knowledgeman/2 $899

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NEW FEATURES FOUND IN KNOWLEDGEMAN/2

Menu system
Last command recall
"Show" info increased
Pluck works with Select
String replacement func
Increased color control
Multi row/col insert/del
Library of groups of files
Context Help
Date to Julian
Import DIF files
Ignore marked records
Drain type-ahead buffer
Path in commands
Spreadsheet design improvements
Command line editing
New Integer field type
* indicates all fields
WHILE sub for FOR
Initialise arrays
Available memory

Thumbnail view of Knowledgeman add-ons

KPAINT: If the dBase II screen design program is aptly named ZIP, the Knowledgeman program should be called "GLUG". KPAINT is so poor, it is suprising that it accompanies a class act like Knowledgeman. It is not a free form design program where you wander around the screen putting in titles and fields. Every step of the screen design process requires trudging through a nest of menus. To insert a mere heading on a color screen, expect about 15 steps. Add an additional six for each field. Colors overlap in a left to right, top to bottom method and not in the order in which they are created. This takes a great deal of planning. Each color area on the screen can only have one foreground color. At least this is better than the Kamikaze line-by-line screen design from within Knowledgeman, where one mistake means a whole new start.

KGRAPH: This is more like what you would expect. A graph can be drawn on a color monitor from spreadsheet or database information. There are flat, stacked, percentage and cumulative bars, exploding and normal pies and line graphs, together with an attractive three-dimensional solid bar graph, an area graph, a scatter-graph and high-low-close. It can also plot a graph of a function and has free form graphing, which is like a complex LOGO. Four graphs can be put on the one screen and in dual intensities with 16 background and 12 foreground colors. Graphs are drawn as quickly as in 1-2-3 and the commands are straightforward. The greatest deficiency is in the printing of graphs. Only IBM PC Graphics and Mannesmann Tally printers are supported, although there is a good range of plotters. As with Knowledgeman itself, printing routines seem an afterthought to an otherwise excellent product.

KTEXT: Without KTEXT, full interaction with, and testing of Knowledgeman procedures becomes burdensome. KTEXT should have been part of the basic package as it is a flexible text editor which is integrated fully with Knowledgeman. In fact, it is as good as most full-featured word processors. It offers such features as word wrap, programmable function keys and line numbering. Printing is accomplished by use of formatting codes (taken from the UNIX ROFF standards) and is accordingly difficult. KTEXT should be used interactively with Knowledgeman and, in that context, is an essential and comprehensive tool.

NEW FEATURES FOUND IN KNOWLEDGEMAN/2

FEATURE	KMAN	dBASE II	dBASE III
Records per File	65,535	65,535	1 billion
Fields per Record	255	32	128
Characters per Record	65,535	1000	4000+MEMO Field*
Characters per Field	65,535	254	512,000-MEMO Field
Open Data Files	No limit	2	10
Numerical Accuracy	14 digits	10	16
Memory Variables	Unlimited	64	256
Copy Protected	No	No	Yes
Field Pictures	Yes	No	No
Virtual Fields	Yes	No	No
Date Functions	Yes	No	Yes
Help Screens	Yes	Yes	Yes
Menu driven option	Yes	No	Yes
Security system	Yes	No	No
Mixed ascending and descending in indexing	Yes	No	No
Browsing in selected Fields	Yes	No	No
Control Break Grouping	Yes	No	No
Statistics	7	No	3
Report Generation	Hard (easy with K-Report)	Easy	Easy
Macro Nesting	Yes	No	No
Built in Editor	Optional	Yes	Yes
Spreadsheet	Yes	No	No

*A MEMO field can contain 4,000 characters if the dBase III editor is used and 512,000 if an external editor creates the text. Only 10 characters are put in the field with a pointer to the text file.

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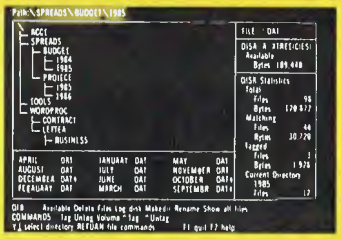

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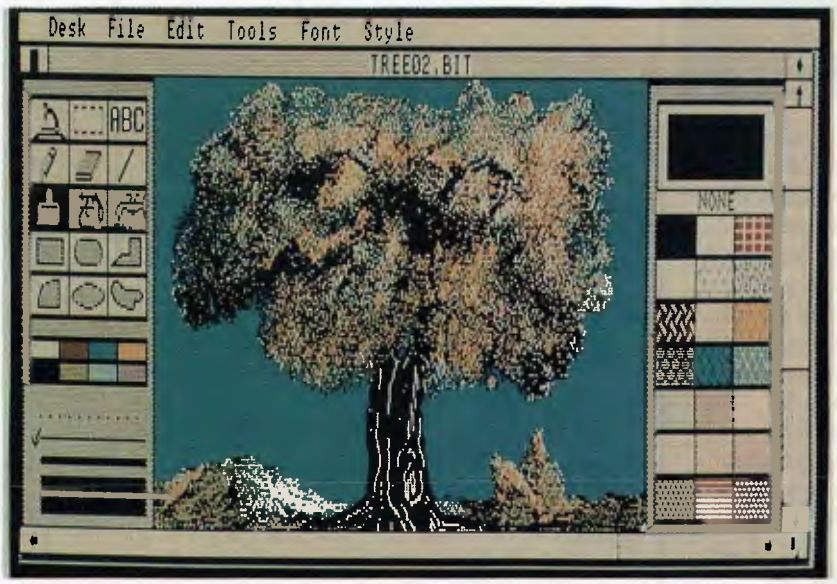
The Painter's Algorithm

Richard Chandler and Gary Faulkner describe a graphics algorithm to remove the hidden lines from three-dimensional objects.



Considerable energy has been spent over the past few years developing ways for computers to render three dimensional objects. Such procedures often contain some form of a hidden line or hidden surface algorithm that confronts the problem that portions of a computer-generated object, once rendered, may block off other objects or other portions of itself.

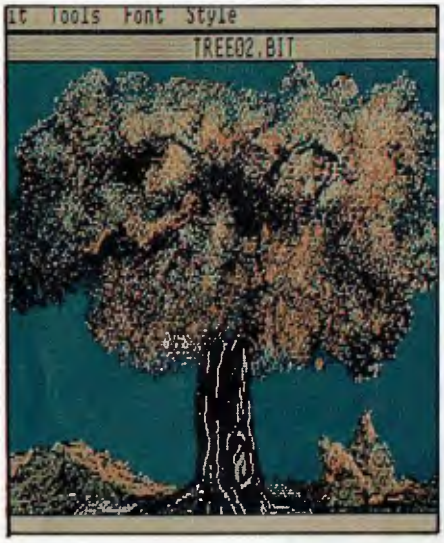
An algorithm intended to satisfy this consideration would require much computer time and memory and would be incredibly complex. The process can be simplified, however, if advantage is taken of the special properties of the surfaces being rendered.

The case chosen for discussion here is one frequently encountered in university mathematics courses. It involves the surface determined by the graph of a function of two independent variables (the graph of $z = f(x,y)$). This equation predetermines the visual priority of the surface elements, and no depth sorting is necessary.

In graph form, the domain of this function is a rectangle that is divided into a grid of smaller rectangles. The values of the function, computed at the vertices of these small rectangles, produce an array of points (x_i, y_j, and z_{ij}) on the surface of the rectangle. By using line segments to connect the points at adjacent vertices, a new surface of polygons is drawn. The natural ordering of the points at the vertices corresponds directly to the depth priority of each new surface element. Elements further from the viewer will be drawn to indices with relatively smaller values. Likewise, elements that appear closer to the viewer will be drawn to indices with higher values.

In other words, surface elements are drawn in order from background to foreground. If a foreground element overlaps a background element the picture becomes confusing, and conflicting lines must be removed. This is accomplished using a variant of the Painter's Algorithm in which the interior of the nearer element is filled with the screen background color, thereby eliminating any hidden lines. The procedure is analogous to that of an artist who paints foreground objects over background objects to eliminate any problem of hidden lines.

This process is made possible with the help of a program that is actually



a series of calls to other procedures, each of which is explained below. The program **(see the listing)** was written for use with the *Turbo Pascal compiler Version 2.0* and, because it incorporates much floating point arithmetic, is recommended for use with the 8087 math coprocessor.

To allow easy modification, the first item in the program is the definition of the function to be graphed. The constant declaration portion that follows contains two sets of parameters intended for specification by the user. The values of *xdiv* and *ydiv* determine the number of subdivisions in the domains of *x* and *y*, respectively. Smaller values assigned to these variables would result in programs that run faster but sacrifice the quality of the surface resolution. If the surface of the function varies considerably over the region of interest, a larger number of subdivisions should be used in order to maintain some degree of quality in resolution.

The three variables xeye, yeye, and zeye indicate the eye position from which the surface is viewed. Because the application of the Painter's Algorithm used in this example proceeds with increasing *x* and *y*, xeye and yeye should both be positive. Unpredictable results may occur if the eye position is within the region where the surface is actually being plotted; therefore, at least one of the two

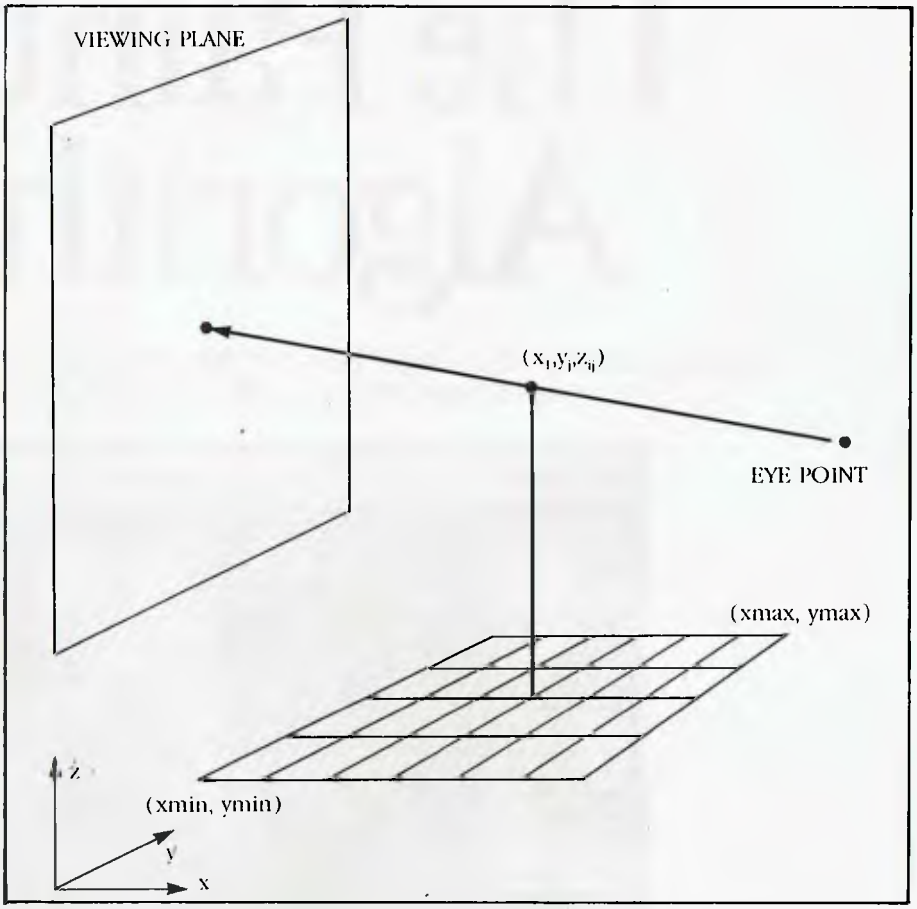


Figure 1: Procedure EVALUATE_AND_PROJECT first calculates point coordinates for the plotted function and then projects the points onto a viewing plane.

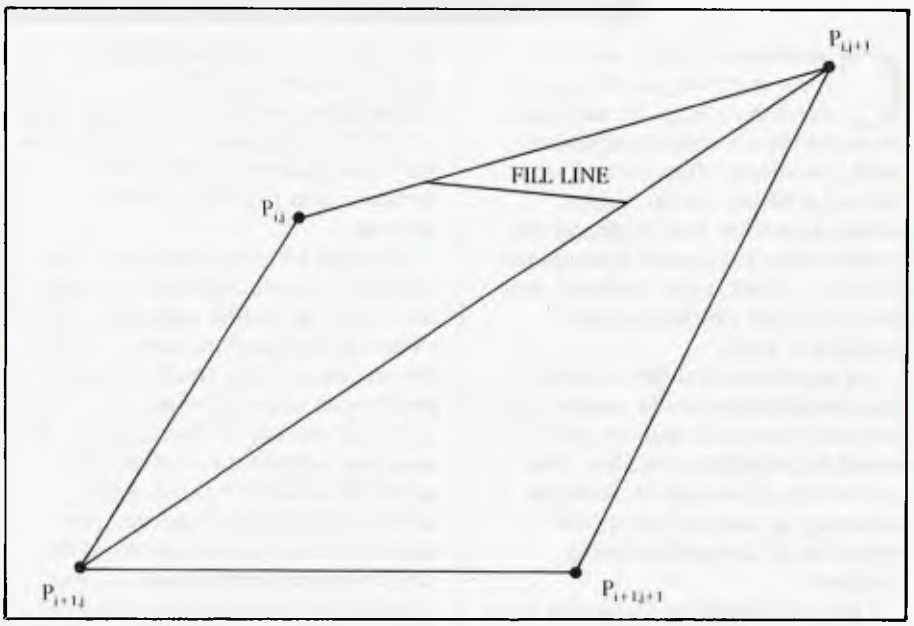


Figure 2: Quadrilaterals in the plotted figure are filled by treating them as two triangles and filling each of the triangles with blank horizontal lines.

variables xeye and yeye should be greater than the maximum value of the corresponding x and y variables. Zeye may be chosen arbitrarily; positive values give a view of the surface from above, negative values give a view from below.

Procedures INPUT_ DOMAIN and SWAP are self-explanatory. EVALUATE_ AND_ PROJECT creates the grid of small rectangles within the surface being rendered, evaluates the function at the vertices of these rectangles, and, finally, projects the corresponding points onto the viewing plane from the perspective of the eye position. The viewing plane contains the origin, is parallel to the z axis, and is perpendicular to the line drawn through the eye position and the centre of the function's domain. The procedures FIND_ EXTREMA and SCALE_ TO_ SCREEN scale the resulting array of projected points (y[i, j],z[i, j]) to fit the size of the screen. This produces a new array (P_{ij} = (p[i,j], q[i,j]) of screen points. The process is shown in **figure 1**.

The heart of the drawing process is performed under the procedure called DRAWBOX. The points $P_{i,j}$, $P_{i+1,j}$, $P_{i,j+1}$, $P_{i+1,j+1}$ form the vertices of a surface element. Except in a few cases, this quadrilateral is formed by the union of the two triangles, P_{ij}, $P_{i+1,j}$, P_{ij+1} and $P_{i+1,j}$, P_{ij+1}, $P_{i+1,j+1}$ **(see figure 2)**. At the same time the surface element is being drawn, these two triangles are filled with the background color of the screen by the procedure TRIBLANK (which is called into operations by DRAWBOX). This removes any lines that the surface element has hidden.

Because of the difficulty involved with consistently finding the seed point within the region to be filled, a seed fill algorithm (such as BASIC's PAINT) is unsatisfactory for use in this case. Each triangle may be filled easily and quickly by simply drawing a series of horizontal lines from the top vertex to the bottom vertex. The endpoints of these lines (the sides of the triangle) can be determined with the help of a version of Bresenham's line algorithm. This algorithm, because it uses only integer arithmetic, is very fast.

The process of actually drawing the horizontal line is accomplished by the procedure LINE, a short, in-line machine-language routine. The two endpoints, as well as the y figure giving the scanline on which the line must be drawn, are passed to LINE, which begins at one endpoint and continues by repeatedly calling ROM VIDEO (software interrupt 10H). This procedure resets the pixel at x,y for each successive x value, thus moving constantly forward toward the opposite endpoint. Any case that is inaccurately filled will remain invisible unless the resolution is coarse. After its interior is filled with the color of the background, the boundary of each surface element is drawn by using line segments to connect its vertices.

LINE is written in machine language for purposes of speed only; if the procedure were rewritten to bypass ROM VIDEO and write directly to screen memory, the plot would progress even more quickly.

Using *Turbo Pascal* and the 8087 coprocessor, the program required slightly more than two minutes to complete the graph of a moderately complicated transcendental function; however, it too more than eight minutes for the same task without the 8087. Most of this time differential is consumed by EVALUATE_AND_PROJECT. Without the coprocessor, actual screen graphing will not begin for six or seven minutes. **Figure 3** is a typical screen plot of a polynomial function.

To achieve optimum results the eye position and domain of the function may need to be adjusted. Keep in mind also that many textbook examples are drawn over nonrectangular domains and use unusual scaling. Plotting such an example over a rectangular domain with this routine could result in a drastically different screen display.

By plotting a function from background to foreground, hidden line removal using the Painter's Algorithm is simple and fairly fast. The routine as presented here can be enhanced for additional speed, for color, or for use with IBM's Enhanced Graphics Adapter. To plot functions other than the one discussed here, simply change the code in function F.

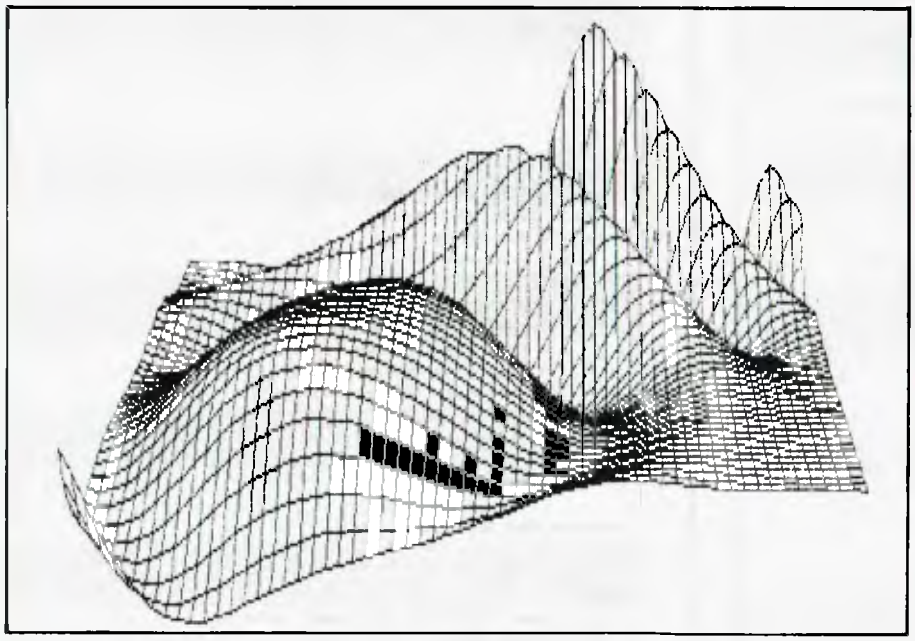


Figure 3: The plot, generated from SURFACE.PAS below, is drawn from background to the foreground, so that lines are hidden as regions in the front plot over them.

Richard Chandler and Gary Faulkner both hold doctorates in mathematics and teach mathematics.

LISTING: SURFACE.PAS

```
Program SURFACE;

{- - - - - DEFINE FUNCTION TO BE GRAPHED - - - - - - - - - - - - }

Function f(x,y:real):real;       { Change this entry in order  }
begin                            {  to graph another function. }
   f := exp(-(x*y+y*y)/90)*cos((x*x+y*y)/40);
end;

{- - - - - DECLARATIONS - - - - - - - - - - - - - - - - - - - - - }

const
   xdiv = 40;            (* * * These two constants control the )
   ydiv = 60;            { number of subdivisions of each axis  }

   xeye = 100;           (* * * These three constants determine )
   yeye = 10;            { the eye position from which the      }
   zeye = 8;             { surface is viewed. }
                  { NOTE : xeye and yeye should be nonnegative.}

var
   i, j                :    integer;
   xmax, xmin, ymax    :    real;
   ymin, zmax, zmin    :    real;
   xdif, ydif, zdif    :    real;
   p, q                :    array[0..xdiv,0..ydiv] of integer;

   y, z                :    array[0..xdiv,0..ydiv] of real;


{- - - - - INPUT EXTREME VALUES FOR X, Y - - - - - - - - - - - - - }

Procedure INPUT_DOMAIN;
begin
   write('Enter smallest value of x  ');
   readln(xmin);
   write('Enter  largest value of x  ');
   readln(xmax); xdif := xmax - xmin;
   write('Enter smallest value of y  ');
   readln(ymin);
   write('Enter  largest value of y  ');
   readln(ymax); ydif := ymax - ymin;
end;

{- - - - - EVALUATE FUNCTION AT GRID POINTS; - - - - - - - - - - - }

{- - - - - PROJECT TO VIEW PLANE - - - - - - - - - - - - - - - - - }


Procedure EVALUATE_AND_PROJECT;
var
   xtemp,xtemp1,xtemp2,ytemp,ytemp1,ztemp,xavg,yavg  :  real;


begin
  xavg := (xmax + xmin)/2; yavg := (ymax + ymin)/2;
  for i := 0 to xdiv do
    for j := 0 to ydiv do
      begin
        xtemp := xmin + i*xdif/xdiv;
        ytemp := ymin + j*ydif/ydiv;
        ztemp := f(xtemp,ytemp);
        xtemp1 := xeye - xtemp;
        ytemp1 := yeye - ytemp;
        y[i,j] := (xeye - xavg)*(xeye*ytemp - yeye*xtemp)/

                  ((xeye - xavg)*xtemp1 + (yeye - yevg)*ytemp1);

        if y[i,j] <> yeye then
          z[i,j] := zeye + (zeye - ztemp)*(y[i,j] - yeye)/ytemp1

         else
           begin
             xtemp2 := yeye*(yavg-yeye)/(xeye-xavg);
             z[i,j] := zeye +
                       (zeye - ztemp)*(xtemp2 - xeye)/xtemp1
           end;
      end;
end;

{- - - - - DETERMINE PROJECTED EXTREMA - - - - - - - - - - - - - }

Procedure FIND_EXTREMA;
var
   ytemp,ztemp  :  real;



begin
   ymax := y[0,0]; ymin := ymax;
   zmax := z[0,0]; zmin := zmax;
   for i := 0 to xdiv do
      for j := 0 to ydiv do
      begin
         ytemp := y[i,j]; ztemp := z[i,j];
         if ytemp > ymax then ymax := ytemp;
         if ytemp < ymin then ymin := ytemp;
         if ztemp > zmax then zmax := ztemp;
         if ztemp < zmin then zmin := ztemp;
      end;
end;

{- - - - - SCALE TO SCREEN - - - - - - - - - - - - - - - - - - - - }

Procedure SCALE_TO_SCREEN;
var
   dy,dz  :  real;
begin
   dy := (ymax - ymin)/639; dz := (zmax - zmin)/199;
   for i := 0 to xdiv do
      for j := 0 to ydiv do
```

```
      begin
        p[i,j] := round((y[i,j] - ymin)/dy);
        q[i,j] := 199 - round((z[i,j] - zmin)/dz);
      end;
end;

{- - - - - EXCHANGE COORDINATES OF TWO POINTS- - - - - - - - - - }

Procedure SWAP(var x1,y1,x2,y2:integer);
var
   temp : integer;
begin
   temp := x1; x1 := x2; x2 := temp;
   temp := y1; y1 := y2; y2 := temp;
end;


{- - - - - DRAWS BLANK HORIRONTAL LINE - - - - - - - - - - - - - }

Procedure LINE(x0,x1,y:integer);
begin
   inline($8B/$BE/x1/              {MOV DI,x1}
          $8B/$8E/x0/              {MOV CX,x0}
          $39/$CF/                 {CMP DI,CX}
          $7D/$02/                 {JGE 2 bytes}
          $87/$F9/                 {XCHG CX,DI}
          $8B/$96/y/               {MOV DX,y }
          $BB/$00/$0C/             {MOV BX,0C00}
          $89/$D8/                 {L1: MOV AX,BX}
          $CD/$10/                 {INT 10H}
          $41/                     {INC CX}
          $3B/$F9/                 {CMP DI,CX}
          $7D/$F7);                {JG L1}
end;

{- - - - - BLANKS TRIANGLE - - - - - - - - - - - - - - - - - - - }


Procedure TRIBLANK(x0,y0,x1,y1,x2,y2:integer);
var
   x3,x4,dx1,dx2,dy1,dy2          :    integer;
   inc1,inc2,nx1,nx2              :    integer;

Procedure BLANK(y:integer);
begin
   while y0 < y do
   begin
      nx1 := nx1 + dx1;
      if nx1 > dy1 then
      repeat
         x3 := x3 + inc1;
         nx1 := nx1 - dy1;
         until nx1 <= dy1;
         nx2 := nx2 + dx2;









      if nx2 > dy2 then
      repeat
         x4 := x4 + inc2;
         nx2 := nx2 - dy2;
      until nx2 <= dy2;
      y0 := y0 + 1;
      line(x3,x4,y0);
   end;
end;

begin
   if y1 < y0 then swap(x0,y0,x1,y1);
   if y2 < y0 then swap(x0,y0,x2,y2);
   if y2 < y1 then swap(x1,y1,x2,y2);
   dy1 := y1 - y0; dy2 := y2 - y0;
   if x1 < x0 then inc1 := -1 else inc1 := 1;
   if x2 < x0 then inc2 := -1 else inc2 := 1;
   dx1 := abs(x1-x0); dx2 := abs(x2-x0);
   x3 := x0; x4 := x0;
   nx1 := dy1 div 2; nx2 := dy2 div 2;
   blank(y1);
   if x2 < x1 then inc1 := -1 else inc1 := 1;
   x3 := x1; dy1 := y2 - y1;
   dx1 := abs(x1 - x2); nx1 := dy1 div 2;
   blank(y2);
end;

{- - - - - DRAWS BOX WITH BLANK INTERIOR - - - - - - - - - - - - }

Procedure DRAWBOX(x1,y1,x2,y2,x3,y3,x4,y4 : integer);
begin
   triblank(x1,y1,x2,y2,x3,y3);
   triblank(x2,y2,x3,y3,x4,y4);
   draw(x1,y1,x2,y2,1); draw(x1,y1,x3,y3,1);
   draw(x2,y2,x4,y4,1); draw(x3,y3,x4,y4,1);
end;


{- - - - - DRAWS SURFACE - - - - - - - - - - - - - - - - - - - - }

Procedure GRAPH;
var
   x1,x2,x3,x4,y1,y2,y3,y4    :  integer;
begin
   HiRes; HiResColor(10);
   for i := 0 to xdiv-1 do
      for j := 0 to ydiv-1 do
      begin
         x1 := p[i,j];    x2 := p[i+1,j];
         x3 := p[i,j+1]; x4 := p[i+1,j+1];
         y1 := q[i,j];    y2 := q[i+1,j];
         y3 := q[i,j+1]; y4 := q[i+1,j+1];
         drawbox(x1,y1,x2,y2,x3,y3,x4,y4);
      end;
end;

{- - - - - MAIN PROGRAM BEGINS - - - - - - - - - - - - - - - - - }


begin
   input_domain;
   evaluate_and_project;
   find_extrema;
   scale_to_screen;
   graph;
   repeat until keypressed;
   TextMode(3);
end.
```

QUBIE' 'AT' ONE

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- Parallel Ports: 2
- I/O Expansion Slots: 8
- DMA Channels: 8
- Interrupt Channels: 16
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- Heating Output: 1229 B.T.U./hour
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- Weight: 42 lbs

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- Access Time:
  - Track-to-Track: 2.8 ms
  - Average: 88 ms
  - Settling: 10 ms
  - Latency: (ave.) 83 ms
- Track Density: 96 tpi
- Tracks per Disk 160
- Encoding Method: FM/MFM

Hard Disk Specifications

- Formatted Capacity: 44 Mb (Option: 70Mb)
- Data Transfer Rate: 5 Mbits/sec.
- Access Time (incl. settling):
  - Track-to-Track: 3ms
  - Average: 30 ms
  - Latency: (ave.) 8.33 ms

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Colour Monitor HR31/200

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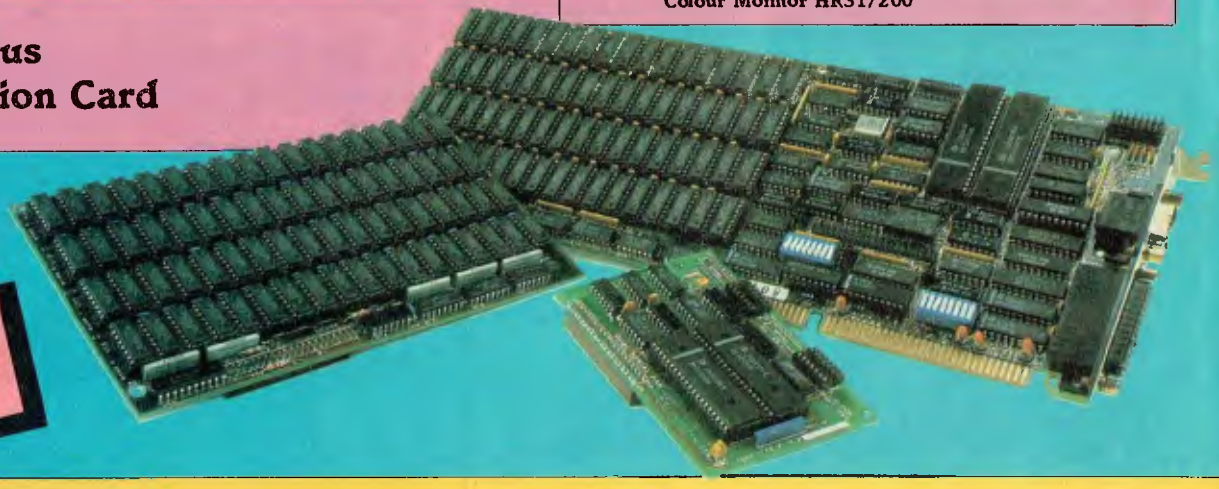

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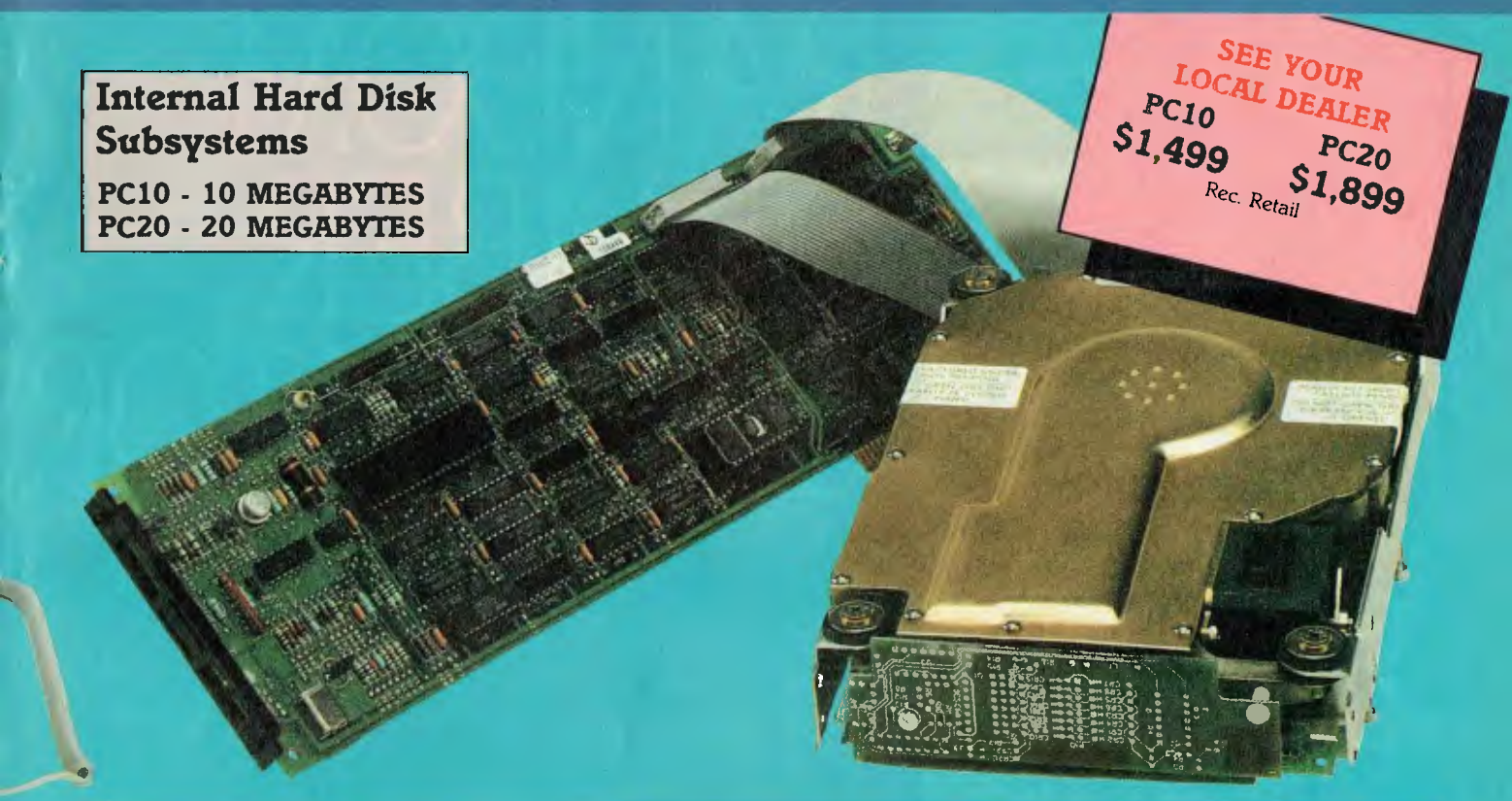

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RANDOM NUMBER GENERATORS

Paul Hultquist explains how to spin the basic roulette wheel inside your PC.

Random numbers are the life-blood of certain kinds of computing. They introduce the vital element of chance in game programs. They are used to test statistical software. Simulation programs depend on random numbers to establish simulated situations. Auditors select files for reviewing with them. Pollsters use them to select participants for surveys.

Several years ago my household was chosen to participate in a marketing survey about some "serious" matter, such as the relationship of income to the kind of cereal consumed. Households were selected by starting with the house on the southwest corner of each block and polling every fifth house in a clockwise trip around the block. If that method had been used in my old hometown, it would have led to a serious bias in the survey results. Each side of the street in that town had six houses, so one "inside" and two corner houses would have been selected on each block. Thus, the pollster would have sampled $66^2/_3$ percent corner houses. Almost all of the big, expensive houses were on corner lots. Practically any random seletion method, whether very good for all purposes or not, would have avoided the bias toward upper-income households.

However, random number

.6791
.457
.268
.1901
.534
.8617
.290
.1031
.859
.276
.7031
.644
.329
.2710
.588
.935
.6102
.593
ILLUSTRATION • TON

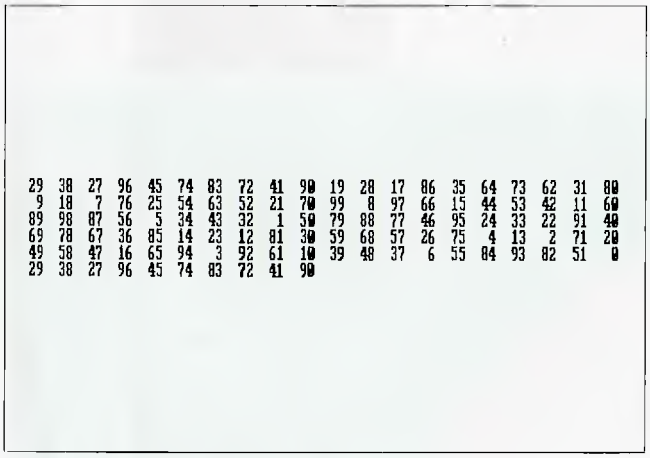

Figure 1: Output from Listing 1

Figure 2: Output from Listing 2

generation can cause, as well as avoid, some problems. In order to simulate the behavior of a sophisticated communications system in which a signal is to be extracted from a background of noise, the programmer must not only generate the signal on the computer — which is easy — but also the background noise — which is another matter entirely. If the random number generator used in simulating the noise has certain statistically cyclical properties, the simulated system may very well detect the "signal" of the random number generator rather than that of the simulated signal generator.

Because of computer users' dependence upon random numbers, it is necessary to know how good they are, how to generate them quickly (especially if they are needed by the millions), and how to avoid some of the pitfalls presented by random number generators included in proprietary software.

The idea of random numbers was born long before computers. History reveals several attempts to use mechanical devices to generate random numbers, including cards, dice, and roulette wheels. These mechanical methods are not satisfactory in the computer era, however, because they tend to suffer from "nonrandomness," and they are difficult to couple to computer hardware in such a way that a random number can be obtained, on demand, in binary form.

Many efforts were made over the years to develop computerized methods for generating random numbers in the same machine that is doing the computation. Even so, every computer centre continued to have its punched card deck of numbers, often derived from the Rand Corporation publication, *A Million Random Digits with 100,000 Normal Deviates* (Rand, 1955), a book whose title made more interesting reading than its contents.

Nonrandom machines

A computer is a deterministic machine, whereas random numbers are products of stochastic

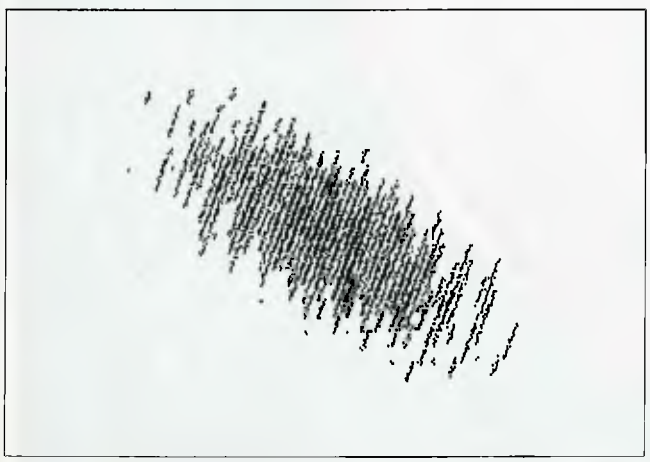

Figure 3: Output from Listing 3

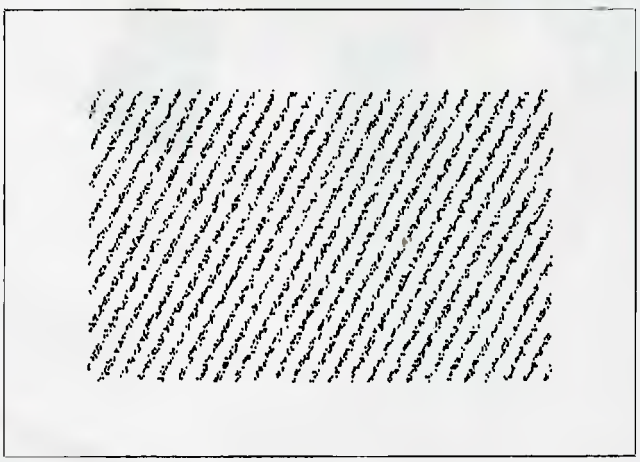

Figure 4: Output from Listing 4

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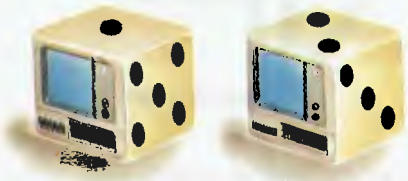

(nondeterministic) processes. How can the use of a deterministic computer to generate a nondeterministic sequence of numbers be justified? The answer is that it can't be. The issue is sidestepped, in a sense, by taking the pragmatic approach: if the sequences are so highly complicated that another computer is needed to predict the members of those sequences, and if the sequences behave statistically the way sequences of truly random numbers should, then the numbers will be accepted as random numbers. Note that no single number is random; only random *sequences* of numbers are meaningful. The statistical behavior and lack of predictability are keys to accepting such sequences.

The desire for computer-generated random sequences led John von Neumann to propose the *middle square method.* Von Neumann, a universal genius who grew up in Hungary, was responsible for establishing a rigorous mathematical foundation for quantum mechanics, developing the theory of games, and suggesting that the binary number system is the natural one for computers. (Considerable evidence indicates, however, that the idea of using a binary system for computers was independently proposed by John Atanasoff of Iowa State University at the beginning of World War II. His contribution was not generally recognized until recently.)

Von Neumann's middle square process involved using the middle digits of successive squares in order to produce a random sequence. For example, if 9268 is the nth number, then its square is 85,895,824, and the n + 1st number is 8,958. Unfortunately, this method tends to fall into short cycles, the most pernicious of which is all zeros. Nonetheless, it helped in the early days of Los Alamos to solve, by simulation, problems that were intractable to classical mathematics.

Most of today's random number generators use some variation of the linear congruential method first proposed by Professor Derrick H. Lehmer of the University of California at Berkeley. His method can be expressed as an equation

$$X_{n+1} = aX_n + c \bmod m$$

where x_n and x_{n+1} are the successive members in the sequence, a is the multiplier, c is an additive constant, and m is the modulus. For example, if $m = 101$, $c = 23$, $a = 21$, and $x_n = 38$,

then $ax_n + c = 798$, which when divided by 101 is $7 + 91/101$. Because mod m means the remainder after division by m, then $x_{n+1} = 91$.

The IBM PC BASIC contains a random number generator RND that is of this type. According to Richard Farmer, manager of product support for Microsoft Corporation, the parameters for this generator are $a = 214{,}013$, $c = 2{,}531{,}011$, and $m = 2^{24}$. PC BASIC also contains an instruction RANDOMIZE. If included in a program, it calls for an integer between -32,768 and +32,767 that may be supplied from the keyboard or supplied with the instruction. This provides a new seed, or starting value, to create a different sequence. The ability to reseed is important in that it allows the user to generate different and (presumably) independent sequences for statistical replication. However, the ability to reproduce the same sequence is helpful, during debugging for example. (That points out another drawback of physical devices for random number generation — it is usually impossible to repeat the same sequence.)

One difficulty in random number generation is the production of very long sequences without repetition. No congruential sequence can exceed m in length; as soon as all of the integers 0 through $m-1$ have been generated, it *must* repeat. Why should the user want all of the integers 0 through $m-1$? With a large value of m, he can generate enough numbers in the sequence to have many independent subsequences and thus can replicate his statistical experiments. In other words, the user can reseed the random number generator and use it many times without worry about duplication.

Another reason to produce all of the integers from 0 through $m-1$ is that if "chunks" of the region from 0 to $m-1$ were missing, the random number generator might not be uniform. Also, having all of the integers enables the user to know the length of the sequence of numbers before the generator begins to repeat itself.

It is known [Knuth, 1981] that the congruential generator can be made to cycle through all of the integers 0 through $m-1$ in some order if these conditions are met:

c must be relatively prime to m (the two cannot have any common divisors)

$a-1$ (sometimes called b) must be a multiple of every prime number that divides into m; if m is prime then b must be a multiple of m

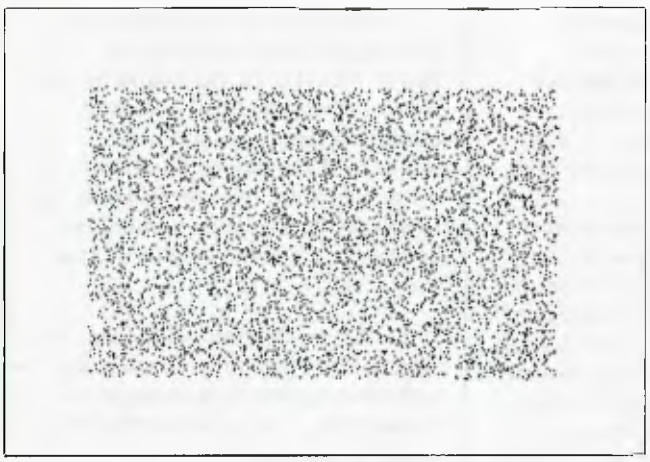

Figure 5: Output from Listing 5

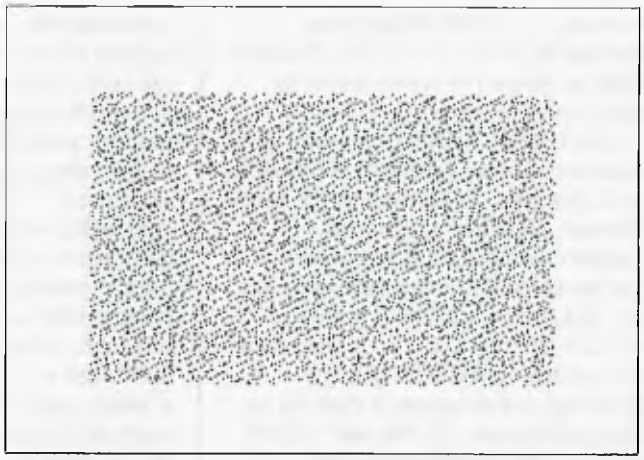

Figure 6: Output from Listing 6

If 4 divides m, then a—1 must be a multiple of 4.

For example, if m = 100, then c can be any prime number under 100, say, 29. Now $m = 2^2*5^2$, so $b = a$—1 must contain 5 (second condition above) and 4 (second and third conditions) as factors. Thus, a suitable b is 20, and a = 21. The user now knows that a = 21, m = 100, and c = 29 will "go maximum cycle" or will generate every integer 0 through 99. Any integer (usually required in software to be less than m) will do as a seed, or starting value. For example, in this generator the sequence that is shown in figure 1 can be generated by starting with zero as the seed. The BASIC program to do this is shown in listing 1.

The sequence as generated doesn't look very random when displayed in this form (as shown in figure 1). If the user were presented with these numbers in sequential order (as read across the page), he would undoubtedly catch on immediately to the pattern of the unit's digits; it would probably take more time to see the pattern in the 10's digits. That is a characteristic of random number generators: the least significant digits are generally the least random.

Why does the IBM PC BASIC function RND give fractions? Most generators embedded in commercial software have several options for presenting results, even though the underlying process is one using integers. The most common way of presenting random numbers is in the form x_{n+1}/m. That is, the random integer is divided by the modulus and expressed in floating point form as a fraction in the range 0 to 1, but not including 1. Because the common methods generate fractions that are

uniformly distributed between zero and 1, the mathematical notation $U[0,1)$ is sometimes used to indicate that the set of possible numbers include 0 but not 1. Programmers who use random numbers by the millions are concerned about the speed of generation. For this reason most generators are written in machine language and called as functions. Often, a desire to speed up the generation process leads to the omission of the addition of c. This creates a set of new problems, such as how to guarantee maximum cycle, which in the c<>0 case was dependent on c not being zero.

If c is chosen as zero, then a must have much more severe restrictions. Since zero cannot be included in the cycle, the seed must be restricted to be non-zero and relatively prime to m. Furthermore, maximum cycle is always less than m; the best solution is to make m a prime number, in which case the cycle length is m—1 for proper a.

The urge for speed also suggests that the value of m be made the "word size" of the computer. Then, when $ax_{n+1} + c$ has been computed, whether c is zero or not, the mod m can be found simply by retaining the "remainder" (least significant) portion in the multiple length register used for multiplication. This is attractive because it eliminates the need for a division to carry out the modulus operation.

RND surprises

The toy random number generator discussed previously is obviously not enough for most users; it is far from random. Because IBM BASIC (and other high-level languages) do not support integers beyond the value 32,767, generating good congruential sequences using programs written in these languages is impossible. No values of m larger than 181 can be used in the linear congruential generator written in BASIC because of integer overflow; therefore, sequences cannot exceed 181 in length.

This is totally unsatisfactory for most purposes, so the user may be forced to write a congruential generator in assembly language and couple it to the high-level language as a function. He may also use what has been provided in the language (which I started to do with RND) or one of

the "randomizers" with RND to give better sequences.

Figure 2 shows what I was expecting to get using RND, and figure 3 shows what I actually got. See listing 2 and 3 for the BASIC programs to run these figures. The coordinates on the screen were

I = 100 + 425(0.3*W + 0.4*X + 0.3*Y)*
J = 25 + 150 (0.3*X + 0.4*Y + 0.3*Z)*

where *W*, *X*, *Y*, and *Z* were found by making four calls to RND. The pattern is supposed to show how correlated random variable behave. (Statisticians please note that the display coordinates are upside-down; the correlation is really positive.)

My next attempt to understand what was going on led to figures 4 through 6, which were helpful in learning something about RND. In these diagrams, the coordinates of the points were determined by

*I = 80 + 465*RND*
*J = 35 + 130*RND*

The differences among the figures appear because, in the case of figure 5, there is a do-nothing call to RND between the calculations of *I* and *J*, and in figure 6, there are two such calls. The very pronounced stripes, particularly in figure 4, are characteristic of congruential generators. All congruential generators behave this way; the trick is to make the modulus very large and the multiplier very good. Then the stripes can be made so close together that they are practically unnoticeable. The points on the screen will occur in such a complicated order that the process appears to be random. (See listings 4, 5, and 6.)

Testing the generators

The crucial test for good multipliers is the spectral test, which is discussed in Donald Knuth's book, mentioned above. He gives a table of several multipliers, both good and bad, along with the findings from the application of the test. Programmers wishing to go to the trouble of writing an assembly language program should take time to investigate the multipliers. Unfortunately, without

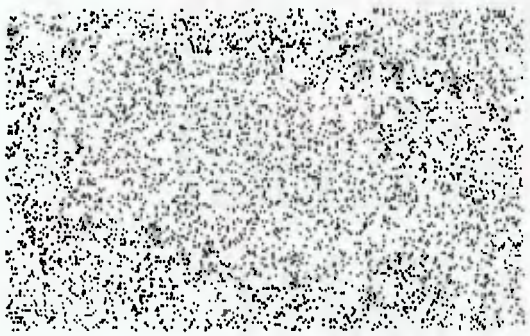

Figure 7: Output from Listing 8

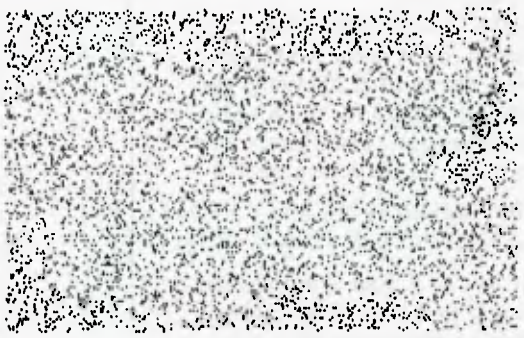

Figure 8: Output from Listing 9

big-integer software some of the conclusive tests, such as the spectral test, cannot be run on the PC in a high-level language.

A more practical method to test sequences of random numbers (perhaps from a generator whose method is embedded in software) is to generate displays such as those shown in the accompanying figures. This is easy and enlightening.

Other tests are statistical. One that is often applied, but that few generators ever fail, is the test for uniformity of distribution. This test asks if there are as many random numbers in the interval from, say, 0.1 to 0.2 as there are in the interval from 0.8 to 0.9. The distribution test is usually applied in the following way: the user decides how many intervals he wants to be tested, for example, 101; then inside of a DO loop, or FOR—NEXT loop, he multiplies each random number by 101, truncates, and adds 1 to avoid a zero index; this number is used as the index to raise the count of occurrences in an array of occurrence counts; the limit on the loop should be chosen so at least 5 counts (10 is better) will occur in each "bin." The BASIC program is shown in listing 7.

The calculated quantity CHSQ is called *chi square*. Note that if all of the bins had precisely 10 (the expected number in the statistical sense) then chi square would be zero. In real life, the counts in the bins typically would be 8, 11, 10, 13, 7, 12, 9, . . ., so that chi square has some non zero value. If, however, the generator is very bad, so that counts are such numbers as 0, 15, 3, 25, 1, 2, 30, . . ., then the value of chi square will be large.

The values of chi square, based upon a theoretical consideration of true randomness, are tabulated and

are available in many places. For this particular example the value of chi square should lie in the range of about 90 to 109 (the so-called 75 percent and 25 percent points; 75 percent of the time chi square should be greater than 90 and 25 percent of the time it should exceed 109). The number of degrees of freedom needed to find the correct entry in the table, is 100. (Only 100 of the bins can have their contents assigned arbitrarily; the 101st bin must take what is left over.)

A single application of this (or any other) statistical test is not enough. The random number generator ought to be reseeded and tested over a number of sequences. The failure of the generator — indicated by chi square values that are too low or too high (below the 95 percent value, for example, or above the 5 percent value) — in isolated cases is generally not of concern. Forty repetitions of the test applied to RND yielded values of chi square that ranged from 87.8 (about 70 percent of the time chi square should exceed this value) to 113.6 (about 20 percent of the time chi square should exceed this value), indicating that one cannot reject the hypothesis that chi square is distributed uniformly with this set of data.

A somewhat more sensitive test for uniformity is the Kolmogorov-Smirnov test. It compares the shape of the statistical distribution function for the generator with what actually occurs and measures the maximum excursions from the ideal. These values are also tabulated.

One of the more critical tests is the so-called runs test. A run is a monotonic sequence of numbers in which each is larger (or smaller) than its predecessor. For example, in the sequence of digits 8,3,5,9,2,4,7,9 the set 3,5,9 is a run (up) as is 2,4,7,9. The first one is of length 3, and the latter one of length 4. The distribution of the lengths of the runs is sometimes an indicator of the quality of the generator; particularly, this distribution seems to show up too-small multipliers.

Knuth shows a very complicated method for determining the value of a variable he calls V, where V is chi-square distributed. The complexity of the method results from the fact that successive runs are not quite statistically independent. I have used this procedure on RND and found

that the values of V seem to be satisfactory. There is a simpler test that involves dropping the variate (uniformly distributed random number) immediately following a run, which relieves the dependency problem. This version gave similar results.

Other statistical tests include the poker-hand test (using random numbers to generate digits 0 through 9 in sets of, say, 5 digits and determining if there are appropriate proportions of two pairs or three of a kind in these sets); the coupon collector test (determining how long it takes to collect a full set of digits from 0 through 9, generated in sequence), and many others. Knuth describes and provides the relevant mathematics for most of the commonly applied tests.

In all such tests the user must remember that exceptional results can occur by chance. If a card-player were dealt 13 spades in a bridge hand, he would fall over dead of surprise, or at least be highly suspicious of the dealer. Nonetheless, such an event can happen with precisely the same probability that we are dealt any nondescript hand. Thus, an occasional bad result from a statistical test of a random number generator should be expected just as an occasional "fall-over-dead" hand in bridge should be expected. The judgment involved is how often to expect either. This is why more than one test is necessary. If the test shows up badly in the 5-percent sense significantly more than 5 percent of the time, then there is cause to worry.

Alternatives to RND

Suppose that a user needs to use random numbers and has little else to use except RND in BASIC. RND does not appear to be the world's best random number generator. What does he do then? Is there any way out except to (a) punt, (b) write an assembly language generator with better properties, or (c) give up and go to a big machine at some service bureau and use an unknown generator that may be even worse?

Two schemes allow for the

Listing 1 Multiplicative Congruential Method

```
10 '              'Toy random number generator
20 '                using multiplicalive congruential method
30 '                - P. F. Hultquist, 1983
40 '
50 CLS : KEY OFF : X = 0      'Starting value
60 FOR I = 1 TO 110
70 X = (21*X + 29) MOD 100    'Generate 110 numbers so that we
80 PRINT USING "####"; X;     'can see the cycle begin to
90 NEXT I                     'repeat
100 LOCATE 10,35
110 PRINT "Figure 1"
120 END
```

Listing 2 Correlated Variable Display with Randomizer

```
10 '          Correlated variable display
20 '          showing problems with RND function
30 '          -by P. F. Hultquist, 1983
40 '
50 DIM ARRAY(50) : SCREEN 2 : CLS : KEY OFF
60 '          W,X,Y,Z are obtained from successive calls to RND
70 '          and then used to generate coordinates of display
80 '          points
85 GOSUB 1000
90 FOR K = 1 TO 5000
100 GOSUB 1100
101 W = V : GOSUB 1100
102 X = V : GOSUB 1100
103 Y = V : GOSUB 1100
104 Z = V
110 I = 100 + 425*(.3*W + .4*X + .3*Y)
120 J = 25 + 150*(.3*X + .4*Y + .3*Z)
130 PSET(I,J)
140 NEXT K
150 '         Print label for display
160 LINE (25,10)-(600,10)
170 LINE -(600,190)
180 LINE -(25,190)
190 LINE -(25,10)
200 LOCATE 23,35
210 PRINT 'Figure 2"
220 GOTO 2000
1000 '        Modification of random number generation
1010 '        to introduce "randomizer"
1020 FOR K = 1 TO 50
1030 ARRAY(K) = RND
1040 NEXT K
1050 '        This loads the array with random numbers
1060 '        to be used in the randomization
1070 SPARE = RND
1080 RETURN
1090 '        Enter here on succeeding calls
1100 KA = INT(SPARE*50) + 1        'generate random index
1110 SPARE = ARRAY(KA)             'replace spare
1120 V = SPARE : ARRAY(KA) = RND   'replace used number
1130 RETURN
2000 END
```

Listing 3 Correlated Variable Display without Randomizer

```
10 '          Correlated variable display
20 '          showing problems with RND function
30 '          -by P. F. Hultquist, 1983
40 '
50 SCREEN 2 : CLS : KEY OFF
60 '          W,X,Y,Z are obtained from successive calls to RND
70 '          and then used to generate coordinates of display
80 '          points
90 FOR K = 1 TO 5000
100 W=RND: X=RND: Y=RND: Z = RND
110 I = 100 + 425*(.3*W + .4*X + .3*Y)
120 J = 25 + 150*(.3*X + .4*Y + .3*Z)
130 PSET(I,J)
140 NEXT K
150 '         Print label for display
160 LINE (25,10)-(600,10)
170 LINE -(600,190)
180 LINE -(25,190)
190 LINE -(25,10)
200 LOCATE 23,35
210 PRINT 'Figure 3"
220 END
```

Listing 4 Using Successive Random Numbers Generated by RND

```
10 '            Random number generator demonstration
20 '            Coordinates of points in the display are
30 '            derived from using successive random
40 '            numbers generated by RND
50 '            -by P. F. Hultquist, 1983
60 '
70 SCREEN 2 : KEY OFF : CLS
80 FOR K = 1 TO 5000
90 I =  80 + 465*RND
100 J = 35 + 130*RND
110 PSET(I,J)
120 NEXT K
130 '
140 '           Arrange display
150 '
160 LINE (25,10) - (600,10)
170 LINE -(600,190)
180 LINE -(25,190)
190 LINE -(25,10)
200 LOCATE 23,35
210 PRINT "Figure 4"
220 END
```

Listing 5 Using Successive Random Numbers with One Number Skipped

```
10 '            Random number generator demonstration
20 '            Coordinates of points in the display are
30 '            derived from using successive random
40 '            numbers generated by RND with one number
41 '            skipped between calculation of I and J
50 '            -by P. F. Hultquist, 1983
60 '
70 SCREEN 2 : KEY OFF : CLS
80 FOR K = 1 TO 5000
90 I =  80 + 465*RND
95 Z = RND
100 J = 35 + 130*RND
110 PSET(I,J)
120 NEXT K
130 '
140 '           Arrange display
150 '
160 LINE (25,10) - (600,10)
170 LINE -(600,190)
180 LINE -(25,190)
190 LINE -(25,10)
200 LOCATE 23,35
210 PRINT 'Figure 5"
220 END
```

generation of more-random sequences from less-random ones. The first uses a vector of, say, 50 variates that have to be loaded into the vector at the beginning of use. One extra variate is kept as a spare. When a new random variate is needed by the program, the spare is used to calcualte the "random index" of one of the cells of the vector; the contents of that cell are then used to replace the spare and are furnished to the program. Next a call is made to RND to replace the contents of the cell. This method seems to provide sequences of random numbers that have good statistical properties in spite o the lack of randomness of the underlying generator. This procedure (lines 1100 through 1130, listing 2) was used to "clean up" figure 3 to get figure 2.

Execution time for producing these random sequences is somewhat longer than otherwise. Figure 7 shows the results of using this method to produce a diagram similar to those in figures 4 through 6. Reseeding this generator requires reseeding RND and then reloading the array. The BASIC code is given in listing 8.

The second method for generating more-random sequences from less-random ones needs another random number generator to get it started. It is called an additive generator because its method of generation relies on addition rather than multiplication. The equation for the *n*th random variate is given by

$$x_n = (x_{n-24} + x_{n-55}) \bmod m$$

where it is clear that $n > 55$. The choice of 24 and 55 for subscripts is not mere whimsy; these values guarantee that the period of the sequence will be very long, with a minimum period of $2^{55} - 1$, which is in excess of 3.6×10^{16}. If the modulus is less than this number the generator obviously must repeat some of the integers. The sequence will not repeat itself in fewer than this number of variates.

In this case, 16,384 can be used as the modulus because of the additive nature of the generator. At the beginning of the program, declare

Listing 6 Using Successive Random Numbers with Two Numbers Skipped

```
10 '            Random number generator demonstration
20 '            Coordinates of points in the display are
30 '            derived from using successive random
40 '            numbers generated by RND with two numbers
41 '            skipped between calculation of I and J
50 '            -by P. F. Hultquist, 1983
60 '
70 SCREEN 2 : KEY OFF : CLS
80 FOR K = 1 TO 5000
90 I =  80 + 465*RND
95 Z = RND : Z = RND
100 J = 35 + 130*RND
110 PSET(I,J)
120 NEXT K
130 '
140 '           Arrange display
150 '
160 LINE (25,10) - (600,10)
170 LINE -(600,190)
180 LINE -(25,190)
190 LINE -(25,10)
200 LOCATE 23,35
210 PRINT "Figure 6"
220 END
```

Listing 7 Program to Compute Chi Square Test

```
10 '        Program to compute chi square test of uniformity
20 '        of distribution of RND random number generator
30 '        - P. F. Hultquist, 1983
40 DIM COUNT(101)     'Allows for 100 degrees of freedom
50 FOR I = 1 TO 101
60 COUNT(I) = 0       'Zero the count vector
70 NEXT I
80 RANDOMIZE
90 FOR I = 1 TO 1010
100 K = INT(101*RND) + 1   'Compute index of count
110 COUNT(K) = COUNT(K) + 1    'Count the occurrence
120 NEXT I
130 SUM = 0
140 FOR I = 1 TO 101               'Start computing chi square
150 SUM = SUM + (10 - COUNT(I))^2 '10 is the expected number in
160 NEXT I                         'each "bin"
170 CHSQ = SUM/10                  'Finish computing chi square
180 PRINT CHSQ
190 PRINT : PRINT "Another? (Y/N)";
200 A$ = INKEY$ : IF A$ = "" THEN 200
210 IF A$="Y" OR A$="y" THEN 50
220 END
```

Listing 8 Using Successive Random Numbers Generated by RND but Randomized

```
10 '            Random number generator demonstration
20 '            Coordinates of points in the display are
30 '            derived from using successive random
40 '            numbers generated by RND but randomized.
50 '            -by P. F. Hultquist, 1983
60 '
61 DIM ARRAY(50)
62 GOSUB 1000
70 SCREEN 2 : KEY OFF : CLS
80 FOR K = 1 TO 5000
85 GOSUB 2000
90 I =  80 + 465*V
95 GOSUB 2000
100 J = 35 + 130*V
110 PSET(I,J)
120 NEXT K
130 '
140 '           Arrange display
150 '
160 LINE (25,10) - (600,10)
170 LINE -(600,190)
180 LINE -(25,190)
190 LINE -(25,10)
200 LOCATE 23,35
210 PRINT "Figure 7"
220 END
1000 FOR K = 1 TO 50    'Initialization of the
1010 ARRAY(K) = RND     'randomizer
1020 NEXT K
1030 SPARE = RND
1040 RETURN
2000 '          Randomizer
2010 KA = INT(50*SPARE) + 1
2020 SPARE = ARRAY(KA) : V = SPARE
2030 ARRAY(KA) = RND
2040 RETURN
```

Listing 9 Using Successive Random Numbers Generated by an Additive Generator

```
10 '            Random number generator demonstration
20 '            Coordinates of points in the display are
30 '            derived from using successive random
40 '            numbers generated by an additive generator
50 '            -by P. F. Hultquist, 1983
60 '
70 DIM ARRAY(55)
80 GOSUB 1000
90 SCREEN 2 : KEY OFF : CLS
100 FOR K = 1 TO 5000
110 GOSUB 2000
120 I = 80 + 465*V
130 GOSUB 2000
140 J = 35 + 130*V
150 PSET(I,J)
160 NEXT K
170 '
180 '           Arrange display
190 '
200 LINE (25,10)-(600,10)
210 LINE -(600,190)
220 LINE -(25,190)
230 LINE -(25,10)
240 LOCATE 23,35
250 PRINT "Figure 8"
260 END
1000 FOR K = 1 TO 55
1010 ARRAY(K) = RND
1020 NEXT K
1030 JA = 24 : KA = 55  'Initialize the pointers
1040 RETURN             'and return
2000                    'Randomizer
2010 SUM = ARRAY(JA) + ARRAY(KA)
2020 IF SUM>=1 THEN SUM = SUM - 1
2030 ARRAY(KA) = SUM
2040 JA = JA - 1 : KA = KA - 1  'Move the pointers
2050 IF JA=0 THEN JA = 55       'Manage the circular
2060 IF KA=0 THEN KA = 55       'buffer
2070 V = SUM
2080 RETURN
```

```
DIM X (55)
DEFINT I,J,K,X
J = 24: K = 55
(RANDOMIZE) 'If desired
FOR I = 1 to 55
X(I) = INT (16384*RND)
NEXT I
```

To call for a number that is uniformly distributed on [0, 1), write

```
X(K) = (X(K) + X(J)) MOD 16384
U = X(K)/16384
J = J — 1 : K = K — 1
IF J = 0 THEN J = 55
IF K = 0 THEN K = 55
```

The statements following *U = X(K)/16384* convert *X* into a circular buffer so that nothing but pointers need be moved as the program progresses. Reseeding the additive generator also requires reseeding RND and reloading the circular buffer with 55 new numbers.

A floating-point variation of this method was used to produce figure 8. In this version the array *X* is loaded directly from RND and thus avoids the integer operations entirely. Instead of

```
X(K) = (X(K) + X(J)) MOD 16384
U = X(K)/16384
```

write

```
X(K) = X(K) + X(J)
IF X(K) = >1.0 THEN X(K) =
   X(K) — 1.0
U = X(K)
```

This provides a little more speed than the integer version. Listing 9 is the program for this variation.

Is RND good enough? It probably would be satisfactory for taking a poll or running a game, but not for very sophisticated applications such as studies in communications theory or simulations in which successive calls to RND are expected to produce independent variates. For those purposes, one of the randomizers described above would be better. The user could write his own generator in assembly language using a set of multiplier and modulus recommended by Knuth. ■

Paul Hultquist is a professor of electrical engineering and computer science.

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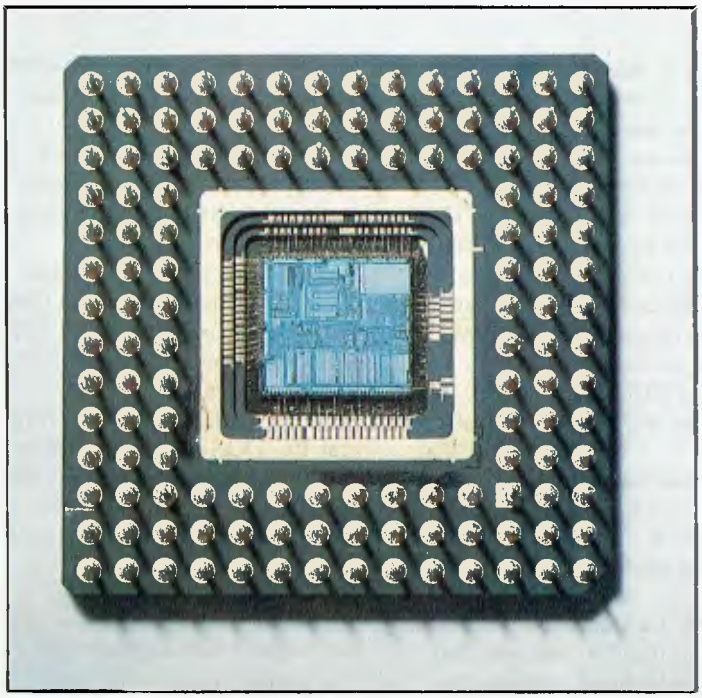


Intel's 80386 chip

Before the decade is out, Intel Corp. claims its new 80386 microprocessor will help bring mainframe power to the word of desktop computing. Among the wonders made possible by this 270,000-transistor chip are robots than can "see" and "think"; miniaturized private-branch exchanges (PBXs) than can manage a corporation's voice and data traffic; and engineering workstations that can run the Unix operating system while doubling as file servers and gateways in local-area networks.

Even more exciting for desktop users is the potential the 80386 has for creating a "dream PC" — one that would enable users to run every PC-DOS application that's ever been written at breakneck clock speeds up to 20MHz. Perhaps as soon as seven months from now, this dream could become reality. Several sources close to IBM have reported that the Entry Systems Division (ESD) has been developing prototypes of a desktop computer with an 80386 processor, and that research has been going on for more than a year, both at the ESD labs in Boca Raton and at IBM's Thomas J. Watson Research Laboratories in Yorktown Heights, New York.

In an October press conference, ESD President William Lowe delivered an official statement that IBM "is committed to continuing the architectural compatibility of the PC product line" and "looks forward to exploring the potential" of the 80386.

And what potential it has! The 80386 offers programmers a staggering 4 gigabytes of physical memory per task and 64 terabytes (64 trillion bytes) of virtual memory. Virtual memory is memory the computer thinks it has, but actually doesn't. It allows the 80386 to make efficient use of physical memory by storing only the portions of programs and data necessary for execution. Code that is not immediately necessary is stored elsewhere, usually on a hard disk or some other mass storage device.

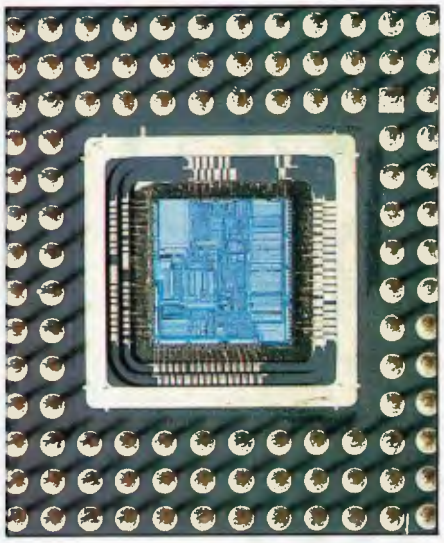
If an application program calls for code that is not resident in physical memory, the 80386 informs the operating system, which then retrieves the data. The transfer is completely transparent to the application program.

The 80386 also has the ability to run "virtual machines" within the chip's protected mode, which was designed for multiuser, multitasking operating systems such as Unix. Applications installed on a virtual machine execute as if they were running independently on their own computer, when in fact, they are running simultaneously with a number of other applications on the same 80386-based machine. The 80386 juggles its processing resources so quickly that the applications behave as if they have the entire system to themselves.

Virtual memory and virtual-machine capability are concepts imported from mini- and mainframe computers. With this kind of power behind it, an 80386-based "dream PC" could run hundreds of PC-DOS applications simultaneously, with no practical limit on memory requirements.

Although the promises are tantalizing, the PC world may be in for a letdown unless Microsoft and other software developers get busy designing applications that can tap the power of the 80386 chip. PC-compatible applications today are still written to run in 640K bytes or less of memory, a mere fraction of the 80386's capacity.

Programmers will need compilers, debuggers and other tools that will allow them to write applications that



exceed the 640K-byte limit of PC-DOS. These tools may become available with the introduction of DOS 5.0, a new operating system rumored to be under development at IBM, and designed specifically for use on 80286-based machines.

But developing new applications that take advantage of the 80386's nearly limitless memory is only one of the obstacles facing the software industry. If the 80386 is to permit multiple operating systems to run on a PC — as Intel has promised it will — then some sort of supervisory code will be required.

"Intel keeps talking about being able to run multiple operating systems at the same time," said Motorola Inc.'s technical specialist Thomas Johnson, "but to do that you'd need to write a virtual master, an operating system that supervises others underneath it. That's a bear of a job that may take a year or two to write."

An example of a virtual master is IBM's Virtual Machine (VM) operating system for mainframes. Taking advantage of VM's supervisory code, mainframe users can run applications like IBM's Customer Information Control System (CICS) and other operating systems, such as Unix.

Andrew Seybold, editor-in-chief of the *Seybold Report on Professional Computing*, agreed that IBM's mainframe technology will inevitably migrate down to the desktop. "The 80386 has the horsepower to run all of the mainframe applications, especially on a local area network," he said.

"What will really be interesting is to see what the chip does to sales of IBM minis. IBM has never made a micro that they didn't cripple in order to protect its high-end systems," Seybold noted. In this case, however, "IBM may have no choice but to use everything the 80386 has to offer. If they don't," he said, "someone else will."

Intel's competitors contend that the 80386 may never live up to the hype that surrounds it — especially concerning its potential role in IBM's product line.

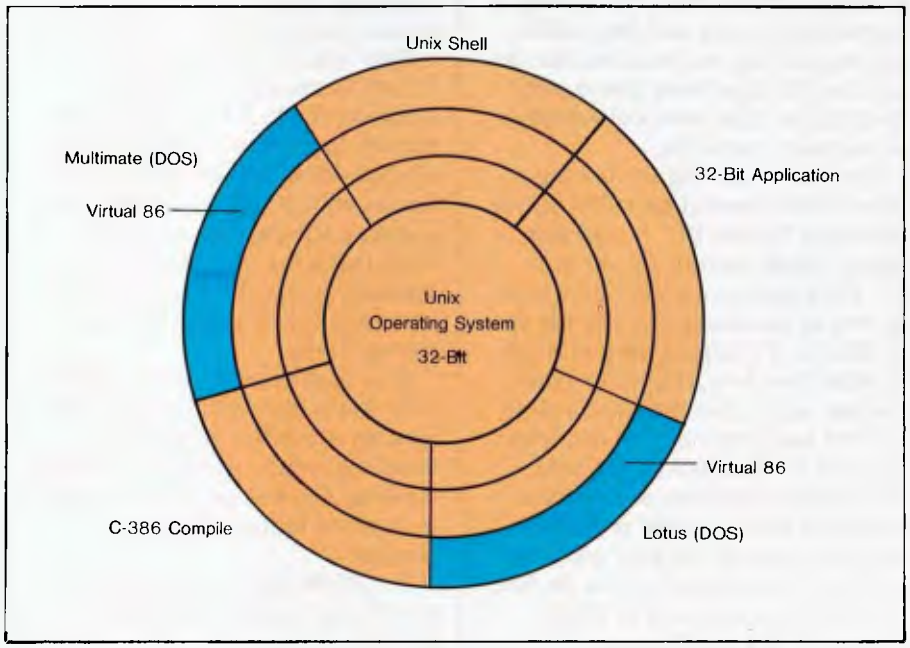
"The 80386 is a transition product — so much so that I'm not sure that IBM will want to build a computer around it," said John Ferrick, director of strategic marketing for National Semiconductor Corp., located in Santa Clara, Calif.

Ferrick speculated that, despite its public posturing, IBM has not guaranteed Intel that it will build a PC based on the 80386 microprocessor. "IBM likes to skip the transitional parts, as they did when they skipped over the 80186 and 80188 to build the 80286-based AT," he said.

Officials in Motorola Inc.'s Microprocessor Group weren't prepared to write off the 80386, but they did assert that some manufacturers may bypass the potential of the 80386 — as they did with that of the 80286 — in order to await yet another generation of Intel microprocessors.

Motorola's Johnson also doubted that PC-DOS software developers would be able to migrate the base of existing PC-DOS applications to the more powerful architecture of the 80386.

The applications software community, meanwhile, has developed a wait-and-see attitude. "All indications are that the 80386 will give us more consistent and powerful solutions to our users' problems," said Ed Belove, Lotus Development Corp.'s vice president of research and development. "We in the [software-development] industry have been nibbling around artificial intelligence and graphics, and the 80386 has a lot of potential in those areas. However, it's going to take us a while to figure



The 386 chip will enable users to run PC-DOS and Unix operating systems at the same time. The 386 traps input/output to allow hardware emulation of the 8086 processor.

out how to exploit that potential."

Despite the problems in adapting it for desktop use, the 80386 is an undeniable achievement. It doesn't matter when IBM produces the 80386-based "dream PC", or whether IBM comes out with such a machine at all. Intel has given the desktop world a passport to the mainframe universe. It's up to those in the desktop sphere to figure out when and how to use it. ■

PC users' concerns about compatibility and performance will disappear when and if the 80386 microprocessor turns up in desktop computers. In the meantime, however, IBM's newest desktop computer, the PC AT, contains the 80286 chip — a powerful microprocessor in its own right, but one plagued by incompatibility problems when users attempt to run PC-DOS applications in its protected mode.

Intel designed the 80286 in 1978, when Unix appeared to be the operating system of the future. Responding to this trend, Intel designed the 80286 with two operating modes: "protected mode," which customises the 80286 for the multiuser, multitasking capabilities of Unix; and "real mode," in which the 80286 emulates the 8088 microprocessor in the PC.

The PC's 8088 microprocessor has a relatively simple architecture, placing few restrictions on how programs manipulate its internal storage locations or "segment registers." Because the 80286 exactly emulates the 8088 in real mode, it has little trouble running applications that were written for the 8088.

The operation of the 80286's protected mode is considerably more complex. As part of its memory-management and protection functions, the 80286 constantly checks to see that its registers are used only for their intended purpose of pointing to available memory.

Many PC-DOS applications, however, have adapted the segment registers for other uses, a deviation that causes the 80286 to develop a serious case of technical heartburn when the applications are run in protected mode. Because the registers are being used for other purposes, the microprocessor cannot find what it considers to be valid memory pointers when it conducts its search. Consequently, it stops execution of the program.

Programmers have struggled to resolve this problem ever since the 80286 became generally available in 1982. Currently, the only feasible solution is to create an "exception handler," a software program that allows DOS applications to run in protected mode.

Unfortunately, the task of writing a generic exception handler that can transparently handle all DOS applications has proven to be insurmountable. In order to develop a universal "fix," the writers of exception handlers must be able to assume that all applications software fully conforms with Intel's programming guidelines for the 8088 microprocessor.

In fact, many popular applications programs violate the programming rules to give faster performance. Lotus Development Corp.'s *1-2-3*, for example, bypasses PC-DOS altogether when it displays information. Instead of interacting with the operating system, the program writes directly to the PC's screen memory.

This approach works fine when *1-2-3* is running on an 8088-based machine or in real mode of an 80286-based machine. But it makes it nearly impossible for programmers to develop a generic exception handler that "tricks" PC-DOS software into running in the protected mode of an 80286-based machine. It simply isn't possible to design a solution that compensates for the quirks of each individual program that runs under DOS.

Even if software developers customized an exception handler for a specific PC-DOS program, the application would execute too slowly for most users' tastes.

With the aid of an exception handler, *1-2-3* could run faster in protected mode on the AT than it does normally on the PC XT. Older programs, however, could run 10 to 15 times slower than they do on a PC, he pointed out.

One alternative to the exception-handler approach is to write applications that can be used without modification in protected mode. Donato de Phillippis, Intel's product-marketing manager for the 80286, noted that applications written specifically for the 80286's protected mode can execute five to six times faster than those written for the 8088 processor.

As examples, he cited Intel's RMX 286 and Xenix 3.1 operating systems, which run in protected mode and have achieved excellent performance results in benchmark comparisons with competitive systems. However, neither is compatible with either PC-DOS or the majority of business software currently in the market.

Yet another alternative is to develop a new protected-mode operating system. Some industry observers speculate that IBM and Microsoft are collaborating on a protected-mode version of DOS (DOS 5.0), which will support some existing applications, but not all.

Even this solution poses complications, however. If the protected-mode version of DOS materializes, software vendors will be required to modify unsupported applications to make it possible for them to run under the new operating system.

Clearly, a comprehensive solution is many months down the road. In the meantime, users of the PC AT and compatible machines might look forward to an 80386-based computer that will allow them to get everything from their microprocessor that the engineers put into it. ■

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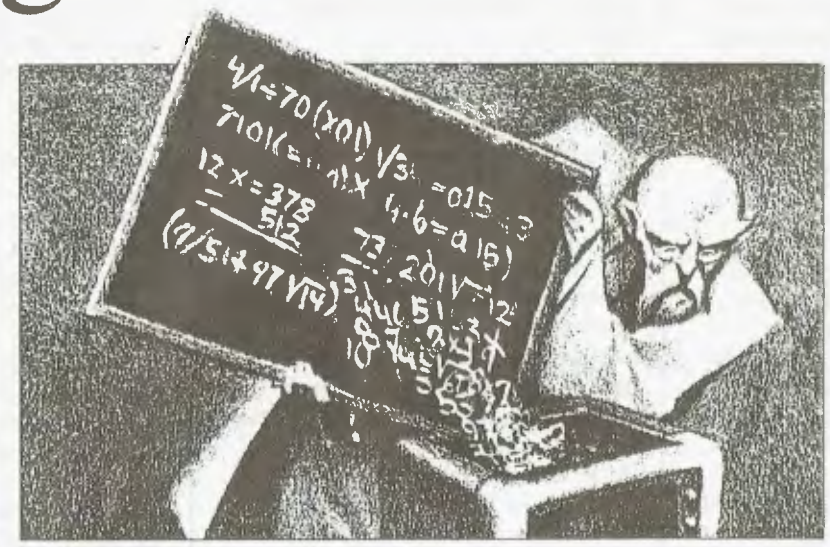


A leading business magazine recently carried an item which claimed that "personal computer software prices are set to plummet, according to the Australian Society of Accountants' newsletter IT forum. The latest issue notes that the industry experts are predicting that prices for basic packages will drop to the $50 to $100 range". Stories of this sort are representative of one of the most common myths haunting the PC industry at present.

The argument that software prices will fall is often based on the success of Borland International, with its very aggressive pricing on Turbo Pascal, Sidekick, Superkey and other software products. Borland has indeed found a lucrative market niche for its products and has done very well out of them, but it is worthwhile to examine exactly what are those products.

With the exception of Turbo Pascal, the remainder of the Borland product range is comprised of what are best described as 'add-on' products. These products are not major software solutions in themselves, but instead tend to enhance the usability of other existing software products. Sidekick, for instance, doesn't do anything particularly significant on its own, but it extends the usefulness of a PC that is running major applications software, because it allows a simple form of task switching. No one is going to buy a PC and have Sidekick as the only software product running. While Reflex would seem to be a standalone product, Analytica had no success in marketing it that way and Borland, following its acquisition of that company, has repositioned Reflex as an add-on to existing major products such as dBase III and Lotus 1-2-3.

Turbo Pascal is a good Pascal compiler for the casual compiler user. It has allowed a lot of users to become familiar with Pascal, and has probably done more to ensure the survival of Pascal as a common programming language than all the academic support the language has ever enjoyed. However, if you start to add up the price of a full Turbo Pascal with the various 'Toolbox' add-ons to make it full featured, it is no longer the low-cost product it initially seemed.

So Borland's low-cost products are not major applications in the same sense that dBase III, Lotus 1-2-3 or Multimate are major applications on the PC. Also, nearly all of Borland's significant products were 'bought' by Borland after someone else had done the R&D and, in most cases, Borland hasn't had to cover product development costs. It is interesting to note that the products that Borland is attempting to develop in-house (as far as I know) such as the Turbo C and Turbo BASIC, have still not appeared on the market.

While there are plenty of low-cost software products on the market in the US (as a quick perusal of any of the US PC magazines will show), none of them, apart from the Borland products, have managed to rack up significant sales on a worldwide basis. There have been many attempts to create major applications products at low cost. The real problem here is that it requires a LOT of money to establish a product in the marketplace, and a low selling price just doesn't yield enough marketing dollars to let enough people know that the product exists. Paperback Software's VP Planner, a claimed Lotus 1-2-3 clone, is a good example, If you have heard about this product at all, it is probably because you've seen the initial press releases on it, or

else it has been mentioned in a commentary like this one.

Product visibility is very important to the user. If a product is not visible, it's unlikely to sell in large enough numbers for the supplier to provide effective support, or for a broad support base to grow out from existing users. In Australia, this is an even more pressing issue. In the continental US, the suppliers of low-cost software have difficulty coping with domestic support and marketing, let alone making sure it's available.

Of the 'Big Three' PC software suppliers, only Microsoft has attempted to introduce a significant product positioned at the low end of the PC software price range. Microsoft has recently introduced Quick BASIC, a very nice BASIC compiler, at a very low price. This is obviously an experiment on Microsoft's part to see how a product which is positioned this way will perform, on a worldwide basis. Microsoft will need to know if the product can cover its support costs at that price, if it sells in significantly greater numbers than its more expensive predecessors, if it covers its marketing costs, and so on. The acid test is — will Microsoft drop the prices on all of its other products to the range established by Quick BASIC? Only time will tell, but I have a feeling it won't.

Ashton-Tate is also experimenting with low-cost software, but through its book publishing activities rather than through software publishing. The products are all 'add-ons' and, once again, only time will tell whether this experiment has been a success.

Some have suggested that the R&D costs of software products are excessive, and that, after the first year or so in the market, there should be no reason why the price of a product shouldn't drop significantly. Let's have a look at this canard.

The falling price of PC hardware is largely due to the fall in the cost of the components due to technological improvements in hardware research and manufacturing, which is becoming increasingly mechanised. Research and design costs are a relatively small part of the cost of hardware. No one complains too much about the several hundred dollars of R&D cost built into a $5000 PC.

Software research and development basically cannot be mechanised, at least as far as the current state of the art goes. Furthermore, the bulk of software originates from the western world, which has higher labor costs, making software R&D an expensive exercise. Nobody has found an effective way of reducing software development by moving to low labor cost developing countries. On the other hand, software is relatively cheap to manufacture, so R&D costs represent a significant proportion of the final selling price.

Many users think that the R&D costs of a software package are primarily to cover the time the program author (or authors) took to develop the software. In fact, a major proportion of R&D costs goes in software testing prior to release. I think everyone knows by now that, no matter to what extent software is tested before release, it is simply impossible to test every possible condition. It is simply not possible to release totally bug-free software. However, that doesn't mean that software suppliers should not try to achieve the highest possible level of reliability in their products through thorough testing. Yet, software testing takes time, and each time a small change is made to a software product, (even fixing a bug found in a previous test), the complete test suite needs to be run again.

Software testing eats up R&D dollars like crazy (and even then a major bug sometimes slips through, as Ashton-Tase, Lotus, Microsoft and other suppliers have all found in the past). Software products usually have an effective life of no longer than a year before the next release arrives. While at least some of the initial 'research' and design of a software product (such as dBase III) is carried over to succeeding releases, the software testing of 'development' cost is entirely new for each release. The new release still has to bear the 'research' costs associated with the incorporated improvements.

One thing that certainly helps to keep the cost of software higher than it otherwise might be, is software stealing. Most major products have a factor built into their price to cover loss of a proportion of sales due to theft through illegal copying. A popular claim is that if software were cheap enough, there would be less incidence of software theft, but nobody has ever been able to prove this. Certainly I see as many (if not more) illegal copies of both PC-DOS and Sidekick (both being 'low-cost' software packages) in my travels, as I see illegal copies of far more expensive packages.

There is little evidence to back up the myth of falling software prices. The effective price of software is falling in terms of the price:performance ratio, and I expect this trend will continue. For instance, Ashton-Tate has recently released Framework II and dBase III Plus, both of which are VERY big leaps forward over their predecessors in terms of power and functionality, yet the price remains the same.

For large volume users of software, there will probably be changes in the way software is sold in the coming years. Corporations are used to paying for services in support of commodity products which they use. In the future, software may be priced in such a way that support (and here I mean long term, broad ranging support, not just technical support) is supplied as a service after the initial purchase. This could have an interesting impact on the general marketplace in terms of software pricing, but the software 'product package' will be quite different in nature from what we are used to today. ■

Bill Bolton is the general manager of Ashton-Tate in Australia, and is well-known to PC users as a pioneer in the field of PC communications and bulletin board systems

New products

Speech recognition for handicapped

Research is underway to develop an environmental control system for handicapped people to increase their independence.

It began a few years ago when a need arose for environmental controls in Sydney's Royal North Shore Hospital spinal unit.

The project is not necessarily confined to people with spinal injury as it also applies to any patients with diseases that affect their ability to walk around and general mobility of movement.

The project is based on speech recognition equipment supplied by Visnet Pty Ltd, a joint venture of Netmap Corporation Limited and Visionhire Australia Pty Ltd.

Visnet provided a speech recognition unit, speech recognition board, speech synthesizer, IBM PC and printer to assist the project.

Due to limitations of the hospital environment, the project has simple aims, beginning with the control of a television, video cassette recorder, radio, telephone dialling and lights. Specialised mechanical devices will be developed at a later stage.

Visnet Pty Ltd,
5th floor,
144 Pacific Highway,
North Sydney, NSW, 2060.
Tel: (02) 92 0902

David Hall (left) and Peter Boardman of Visnet with Leigh Thomas (right) of the Royal North Shore hospital demonstrate speech recognition equipment

Better word processing

Sourceware has announced an upgraded version of *WordPerfect 4.0*, which provides greater processing capabilities.

The developer, Satellite Software International, of Utah, has incorporated a range of refinements, including a built-in thesaurus which gives the user immediate access to synonyms for any words in the document, a split screen allowing two documents to be viewed simultaneously through a horizontal split, three-level undelete, text columns, line drawing, (single or double horizontal and vertical lines) sorting, auto re-formatting and improved proportional spacing.

WordPerfect 4.1 contains five diskettes: thesaurus, IBM systems and compatibles, spelling checker, supplementary that includes the tutorial and printer files, and a program to convert *ASCII, WordStar, DIF*, and other files to and from the *WordPerfect* format.

It requires a minimum of 256K memory, two floppy disk drives or a hard disk, and PC/DOS 2.0 or higher.

Sourceware,
4/73 Albert Avenue,
Chatswood NSW 2067
Tel: (02) 411 5711

On-line bar code reading

Bell & Howell Australia has released an on-line bar code reader designed for use with the IBM PC and XT. Bar coded information can be read with lightpen, slot reader or hand-held laser.

The Scanstar PC compact bar code reader contains sufficient decoding logic for 11 of the most commonly used bar code formats and the company says it is capable of automatically distinguishing nine. Easily installed and requiring no hardware or software modification, the Scanstar PC does not interfere with normal keyboard operation.

There are no dip switches to be manually set. Instead, factory programmed set-up functions can be easily reconfigured from either CRT keyboard, bar coded menus or user generated coded set-up label. All set-up functions are stored in memory for recall at any time.

A range of Scanstars that enable other IBM terminals, such as the model 3178, to read bar code information is also available.

Bell & Howell Australia
Pty. Ltd.
47 Hotham Parade
Artarmon NSW 2064
Tel: (02) 437 7111

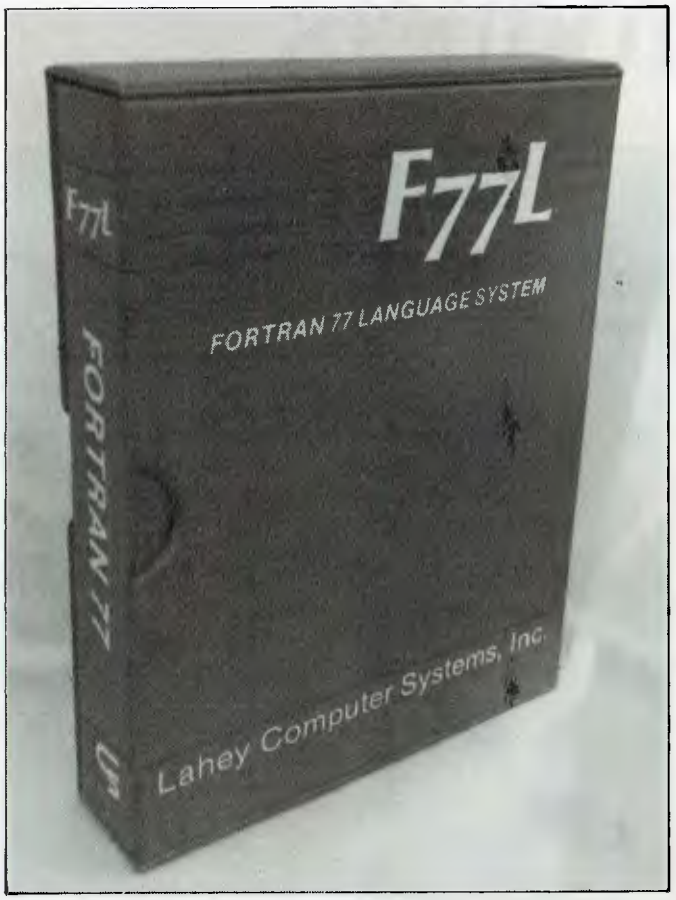
MS DOS Fortran 77 for programmers

F77L by Lahey Computer Systems is a Fortran 77 compiler which meets the full ANSI standard and compiles about three to five times faster than competing products. It has exceptionally detailed error diagnostics and helpful warning messages. These features allow the programer quickly to debug new programs and programs being transferred from other computers.

Several enhancements to the Fortran 77 standard are provided by F77L. These include long names (to 31 characters), additional variable types (LOGICAL*1, INTEGER*2, REAL*8 and COMPLEX*16), optional source format (standard or free), Boolean operations on integer variables, execution of DOS commands from within programs, provision for calling DOS and BIOS functions, program chaining, modifiable carriage control and optional source. The use of the 8087 (or 80287 in the case of 80286 based machines) math coprocessor is compulsory.

Lahey F77L $825

Computer Transition Systems
Box 4553, Melbourne, 3001
(03) 537 2786



The Fortran 77 compiler which works three to five times faster than competing products

Removing transmission errors

Increased speed of data communications, along with expanding application of computer communications in business, has brought the question of accuracy of transmission into focus.

Four significant factors in the transmission of data are the hardware, software, speed of transmission and quality of the telephone lines.

Ideally the hardware and software at both ends would be identical, transmission speed would be relatively low, and the telephone link would be without interference.

Since such conditions rarely exist, Shuttle Datacomm recently released *Error Free*, a device that enables accurate high-speed communication between computers not sharing identical software and over telephone links that are less than perfect.

Not all telephone exchanges are modern, and many lines are subject to random bursts of interference. As distance increases, or the speed of transmission is stepped up, there is greater potential for interference and the resultant loss of accuracy in data transmitted.

Data transmission at 2400 baud means there is more potential for inaccuracy, so unless there is identical software at both ends to enable error checking there is a need for a device such as Shuttle's *Error Free.*

Placed between the PC and modem, the *Error Free* provides error-free transmission at data rates of 300, 1200 and 2400 baud using a complex MNP error-checking technique that involves block transmission, Cyclic Redundancy (CR) checking, and data re-transmission if an error is detected.

The *Error Free* is equipped with a set of DIP switches so power-up parameters can be tailored to a particular application. Switch settings can be changed without having to reset the system.

The *Error Free* also has a microprocessor and built-in firmware that enables commands to be sent and responses received. It operates in three modes: error-free only, error free/transparent, and transparent. *Error Free* automatically determines if the error correcting standard is in place at the receiving unit. If it is, the transmission is accepted and error checked. If not, it turns "transparent" and allows communication to take place without delays but also without error control.

R. F. Computer Communication Pty. Ltd.
Suite 30, Third Floor,
456 St. Kilda Road,
Melb. 3004.
Tel: (03) 267 1011.

More GrafTalk options

GrafTalk now supports more computers and peripherals. This increased support ranges from inexpensive graphics printers to an ultra-high resolution image processing system. It still requires only 128K of memory.

Graphics is hardware intensive and so it is necessary to support many different types of graphics systems. All the new equipment supported is utilised to its full resolution and color capabilities. The new equipment supported includes: Hewlett Packard Laser Jet, Hewlett Packard 7550 plotter, Matrix Image Processing systems, Hercules Monochrome board, Okidata printers, Gould Colourwriter Plotters, Toshiba P1351 printer, STB boards, Tecmar Board, ITT PC Xtra, NCR PC-4 and Olivetti M24.

GrafTalk hardware

Fagan Microprocessor Systems
95 Canterbury Road,
Middle Park, VIC., 3206
Tel: (03) 699 9899

Packard Product Pact

Samna Corp. and Hewlett Pack Inc have entered into a joint development agreement for office automation products.

The first result of the collaboration is *AdvanceWrite,* a family of word processing software packages for the Vectra, an IBM PC AT compatible. *AdvanceWrite* is based on Samna word processing and office automation software, and is also a fundamental part of the Vectra Office, Hewlett Packard's new secretarial workstation.

A plotter for most tasks

A four-pen graphics plotter designed for business, CAD or home applications is the latest product in The TCG Group's graphics range.

The Hitachi model 672 will plot graphs on any type of paper or overhead transparency material, can produce diagrams, charts and other CAD applications as well as a number of types of alphanumeric characters.

TCG says the plotter is ideal for a personal CAD system in both drafting speeds and the commands provided. The four pens are automatically changeable and drawing speed is 200mm/sec. (Acceleration is up to 1G). The plotter is able to make a hatched portion, draw dotted lines or connect respective dotted lines with solid lines at high speed.

The model 672 is capable of plotting alphabet characters with a 3mm size at five characters per second. 24 plotting commands provide for those features most often required in business graphics (such as plotting a straight line, circle, arc, sector, axes and similar) and those used in graphic design for typical CAD applications (forming a window, expanding/contracting a scale, setting a paper size, replacing X and Y axes.)

Software such as *Lotus 1-2-3, Symphony , Graphwriter,* and *SuperCalc 3* are supported. Hewlett-Packard graphics language emulation allows support of a substantial number of additional software packages.

A parallel and serial interface are provided as standard specifications.

The plotter is small and lightweight so is easily transportable and comes ready for immediate use with 50 pages of standard A3 media, four fibre tip pens, and full documentation and cabling.

Hitachi 672 Plotter $1400
The TCG Group
30 Balfour Street,
Chippendale, NSW 2008
Tel: (02) 699 8300

Engineering analysis on PC

Compumod now has MSC/pal 2 for sale in Australia and New Zealand. MSC/pal 2 is an enhanced release of pal, first introduced to Australia early in 1985.

Pal 2 performs static and dynamic analyses of computer models of products and structures to assess their strength and durability.

Models can be analysed with up to 1000 grid points and can be composed of any combination of quadrilateral and triangular plate elements, curved and straight beams, discrete springs, masses and dampers and shear panels.

The 2D membrane elements can be used for both plane stress and plane strain studies. The addition of local co-ordinate systems allows the symmetric analysis of structures such as pressure vessels. Solution capabilities include statics, normal modes, transient response and frequency response analysis. An integrated bandwidth minimiser and double precision arithmetic in all operations increase performance and accuracy.

Interactive graphics capabilities include structural geometry displays with 3D rotation, scaling and element shrink, deformed geometry with stress and displacement contours and animation. X-Y plots for dynamic displacements, velocities, accelerations and response ratios and element static stresses can also be interactively displayed once the solution has been calculated.

MSC/pal 2 data can be transferred to and from other programs and a pal 2 model can be readily converted into MSC/Nastran format to run on a larger computer.

Pal 2 requires an IBM (or compatible) PC XT or AT with 512K RAM, an 8087 (or 80287 for an AT) and the IBM color graphics card.

MSC/pal 2 $3295
Compumod Pty Ltd
10th Floor
20 Martin Place
Sydney 2000
Tel: (02) 27 7405

Solving matrix equations

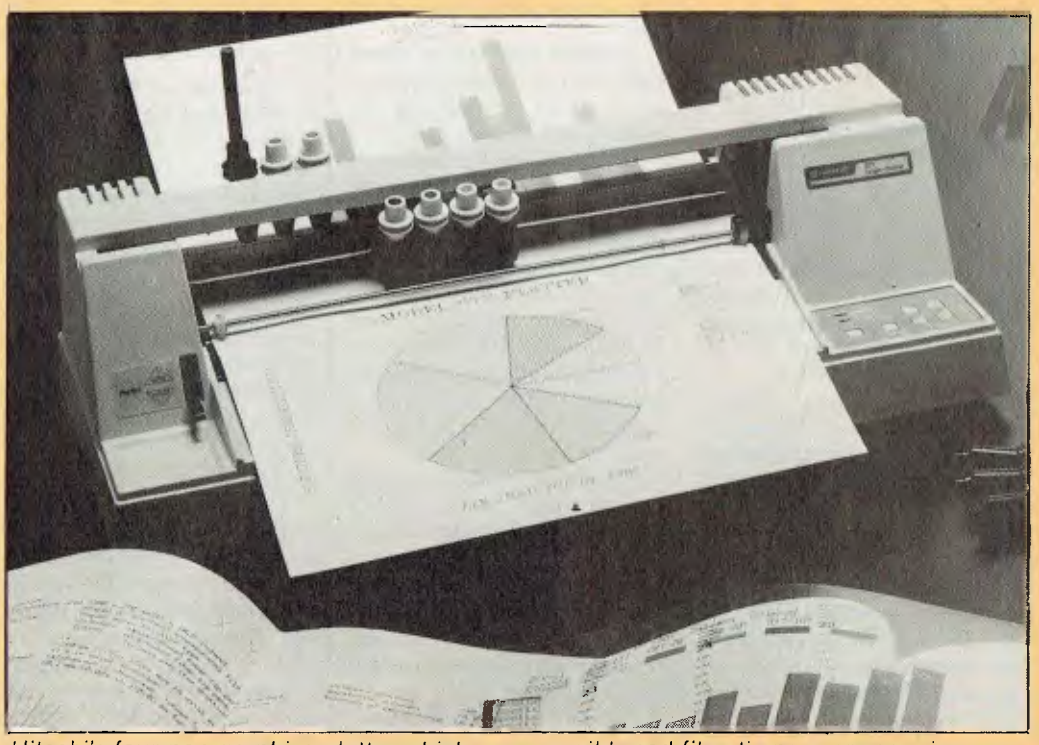
Compumod says it is introducing the MSC/mate software for general matrix equation solutions on a PC.

This product can be used by mathematicians, scientists and engineers to solve a broad range of problems involving simultaneous equations, eigenvalue solutions and iterative algorithms.

MSC/mate uses the PC to display and edit matrices in a manner similar to a spreadsheet and also includes a powerful analysis language with many mathematics and matrix-based functions. MSC/mate has interfaces to *Lotus 1-2-3*. Microsoft *Fortran* and the MSC/Nastran and MSC/pal finite element programs to allow transfer of matrix data.

MSC/mate requires an IBM PC, XT or AT (or compatible) with 512K of RAM, a hard disk and an 8087 or 80287 numeric co-processor chip.

MSC/mate $845
Compumod Pty Ltd



Hitachi's four pen graphics plotter which can use oil based fibre tip pens or ceramic pens

Tower of power — file server

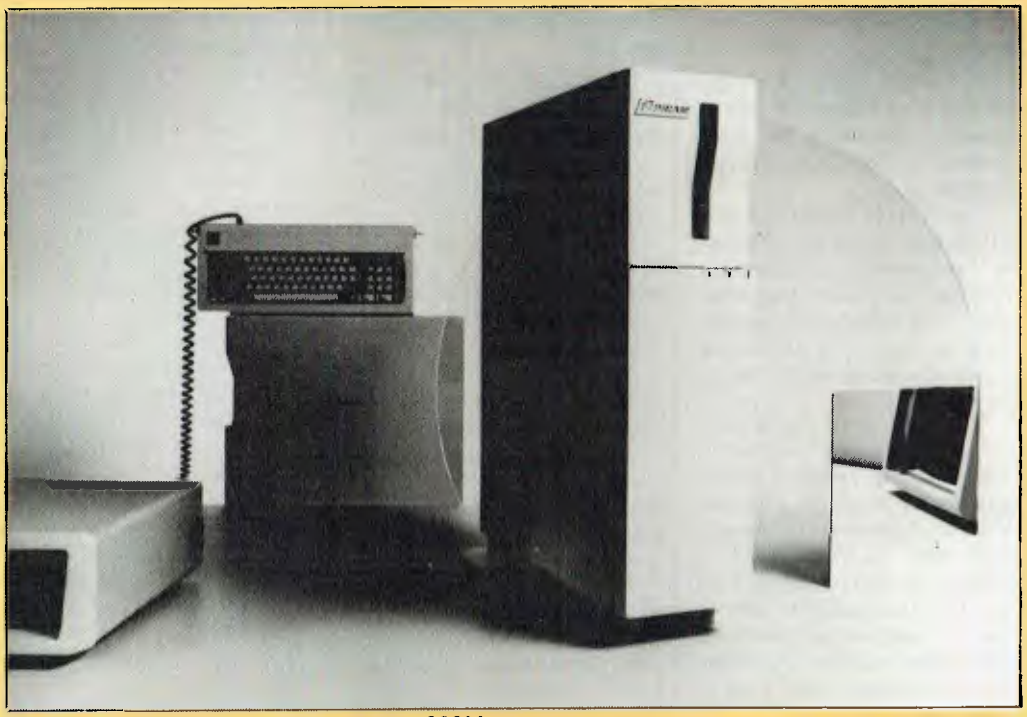
DataTower is a handsome "space centre" for the office environment using PCs, XTs or the new AT.

Priams Data Tower can be daisy-chained to provide the users with mass storage of about a gigabyte. As a single unit, the DataTower can store up to 292 M. An ability to work with 3Com or Novell local area networking software places the Priam tower in a unique position as a massive file server for the IBM PC, XT or AT.

Speed is most important if mass storage is to be employed in a networked environment. Depending on your PC maximum transfer rate, (approximately 0.7M per second for the IBM AT, XT & PC) the DataTower can dump data at the rate of 1.2 M per second.

DataTower's internal back-up performs at over 4 M per minute. This means you can back-up over 2500 pages of information a minute.

Daneva Australia Pty. Limited
64-66 Bay Road,
Sandringham, Vic. 3191
Tel: (03) 598 5622



The DataTower which can store up to 292M

Plant maintenance efficiency

PSDI Australia Pty Ltd, a subsidiary of the US company Project Software and Development, has announced the Australian release of its powerful *Maximo* maintenance manager system for plant and facility maintenance control.

Maximo is claimed to significantly reduce plant down-time and provide considerable savings in many aspects of maintenance operations such as maintenance productivity, unplanned down-time, energy usage, equipment life and spare parts inventory.

Running on both the IBM PC XT and AT, the software package streamlines corrective and preventative maintenance planning and predicts supply shortages well in advance.

To ensure fast, easy operation, the system comes fully equipped with a three button optical mouse device, color-coded screens and customised reporting capabilities.

A special view facility allows users to gain extra details of information by pointing the mouse and clicking a button.

By employing a hierarchical structure for equipment numbering, *Maximo* makes it easy to summarise equipment information including costs at any level up to the total facility. *Maximo* Maintenance Manager allows users to tailor the software to reflect established operating practices, rather than change their existing maintenance procedures.

The Work Order Tracking module allows users to create a Corrective Maintenance Work Order, issued to repair a malfunction, and track it through its entire life cycle. After completion, Work Order details are reported and archived to the equipment history file.

Preventative Maintenance Work Orders are used periodically, for example every two months or 1000 service hours, to ensure a plant is maintained at maximum efficiency. Work Orders are created when a part is due for replacement, rather than after a breakdown.

Preventative Maintenance Work Orders are automatically generated by *Maximo*, eliminating a large amount of paperwork and confusion often found in conventional card systems.

The Inventory Control module provides facilities to keep an accurate record of all parts in stock. When parts fall below minimum levels, purchase orders can automatically be generated. Work orders requiring shorted parts are held until the stock is replenished.

The Equipment History Module contains a record of all equipment — right down to the spare part level. Work can be performed and charged against any level of assembly. This enables access to a complete maintenance history or to track work performed for a specific job plan.

PSDI Australia Pty. Ltd.
76 Berry Street
North Sydney, NSW, 2060
Tel: (02) 923 1344

A boon for PC users

SPL (Australia) Pty. Ltd, as agents for BMS Computer Inc, USA, have released a product which will be a boon to PC users — Easy-Dos-It.

Easy-Dos-It is a menu package which allows the user to access a program or package by selecting the appropriate menu number. The package provides an alphabetical listing of all DOS (2.0 and above) commands, includes built-in tutorials for novice users and provides security with password protection as well as the ability to customise its configuration for each user.

Easy-Dos-It $95
PC Software Division,
SPL (Australia) Pty. Ltd.
Level 7 Gordon Centre,
802 Pacific Highway, Gordon.
Tel: (02) 498 8555.

Terminal emulation from SCA

Software Corporation of Australia has signed an exclusive distribution agreement with Persoft Inc., covering the entire SmarTerm range. All SmarTerm products provide file transfer capabilities which facilitate the transfer of programs between an IBM PC-standard computer and a host mainframe.

Persoft's best known progam to date, *SmarTerm 100,* offers emulation of DEC's VT 100 or the more powerful VT102. It improves on the performance of the original in a number of respects: while the DEC terminal has a single, saved set-up configuration, *SmarTerm* has eight. So users who connect to a number of different hosts can have a set-up for each. *SmarTerm* also allows the user to name the configurations, making it easy to recall which goes with which machine. In addition, *SmarTerm* provides "softkey" definition for commonly used commands. Softkeys are engaged by depressing either the Shift key or the Alt key and the PC's function key at the same time.

SCA
138 Buckhurst Street
South Melbourne, 3205
(03) 699 7255

Video training on tape

Micro Management Services Pty Ltd has been appointed distributor for the Arthur Young Self teaching interactive video and computer based training courses. Micro Management Services specialises in the use and training of accounting and financial modelling systems.

The self teaching video courses, taken over from AY Systems Pty Ltd, include *Lotus 1-2-3, Advanced Lotus, Multiplan, Multimate, WordStar* and *dBase III.*

Each course is centered on a video cassette tape or tapes which can be rented or purchased. Small groups or individuals can train quickly and conveniently, and because no teacher is required, the cost per student is low. Once you have bought the course you can train as many people as you like.

The video sequences start at the beginning of computer education, progress to the basics and then continue through a vigorous workout on advanced features.

Micro Management Services
Pty Ltd
15 Woolrych Crescent,
Davidson, N.S.W. 2085
Tel: (02) 452 3779
452 5765

Scientific software

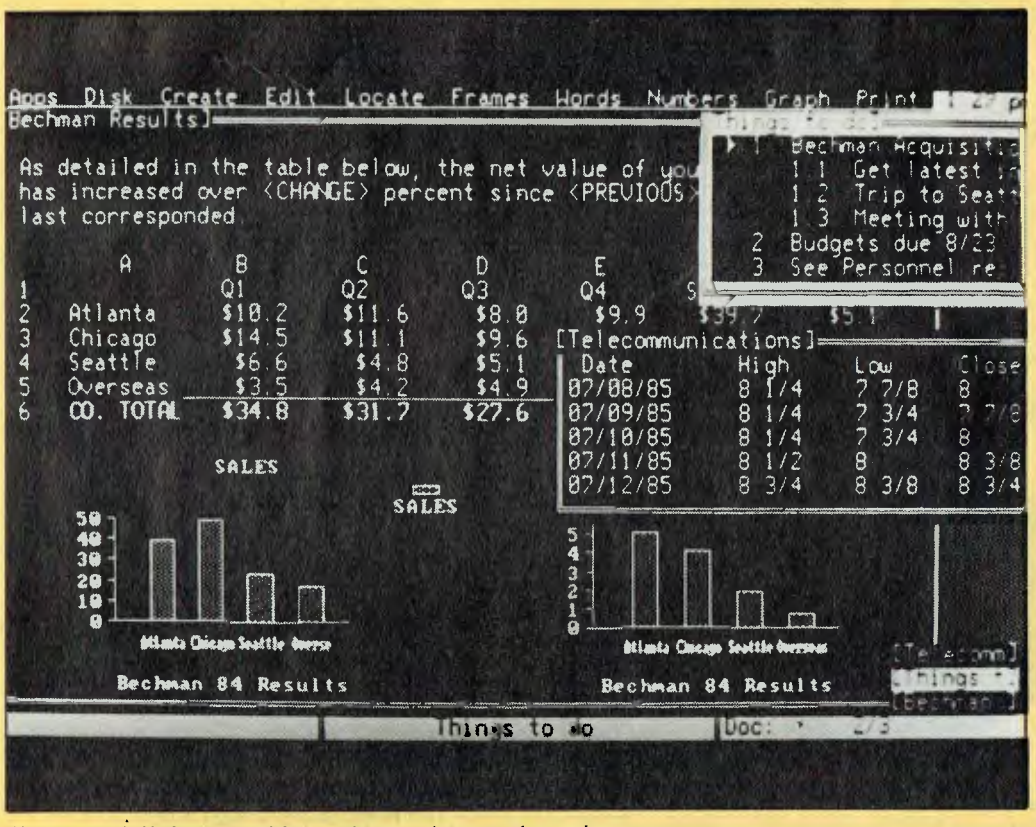
Technical Imports Australia is marketing the *Triad T3* word processing package specifically designed for the scientist and engineer. Complex expressions appear on the screen as they will be printed, such as equations, square-roots, integrals. An expanded library of chemical structures is available. There can be up to 8 defined fonts per document, and an unlimited number in the system. Supplied fonts include Greek, italics, script, mathematical, chemistry, forms, European and Cyrillic (Russian).

Other features of *Triad T3* include: 25 levels of subscripts and superscripts; automatic footnotes; automatic page numbering and dating, unlimited Document size; ASCII file import; and line width, up to 158 characters.

Triad T3 runs on the IBM PC and compatibles, using DOS 2.0 and higher. A color graphics adaptor, or Hercules graphics board. *T3* will run on a dual floppy system, but a hard disk is recommended for heavy use. Output can be to almost every type of impact, ink-jet and laser jet printer.

Triad T3

Technical Imports Australia
Suite 607, 6th Floor,
220 Pacific Highway,
Crows Nest, NSW
Tel: (02) 922 6833



Framework II: frames with words, numbers and graphs.

More Framework

Ashton-Tate's new *Framework II* software for the IBM PC and compatibles allows users to use frames containing words, numbers and graphs where desired in a document or on the electronic desktop screen.

Framework II's new fully-integrated telecommunications module can be invoked for 'background' capturing of information. Users can analyse stock quotes in a spreadsheet as more quotes are being received.

Framework II $995

Burson-Marsteller Public Relations
12th Floor, Network House
344 Queen Street
Brisbane QLD 4000
Telephone: (07) 221 5288

A New Generation of Multifunction Boards:

CONQUEST

Multifunction with Lotus/Intel/Microsoft Expanded Memory and upgradable to PCnet.

Conquest is one board that does the work of three: it's a *multifunction* board with serial and parallel ports and a clock/calendar; it's a *memory* board with up to 2 megabytes of Lotus/Intel/Microsoft EMS Memory; it's a *network* board with the optional PCnet Daughtercard.

Ports

Conquest includes one serial and one parallel port. The parallel port can be configured at LPT1, LPT2, or LPT3; the serial port can be configured as COM1 or COM2. These IBM-compatible ports can be used by any standard software and cables. They can be used with or without interrupts.

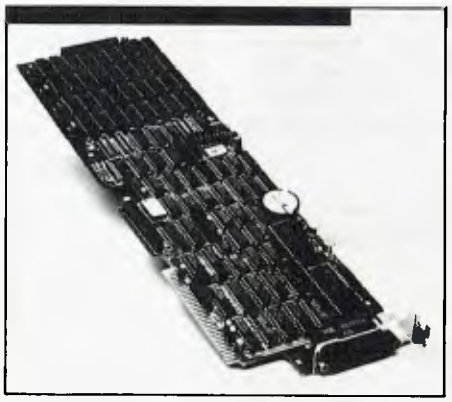
Clock/Calendar

Conquest's Clock/Calendar has a long-life back-up battery so that it keeps time even when the PC is not running. The time and date are automatically set whenever the system is booted, so they never again need to be typed in by hand. An alarm clock allows three different alarm times to be set. Alarm setting number one is retained by the back-up battery.

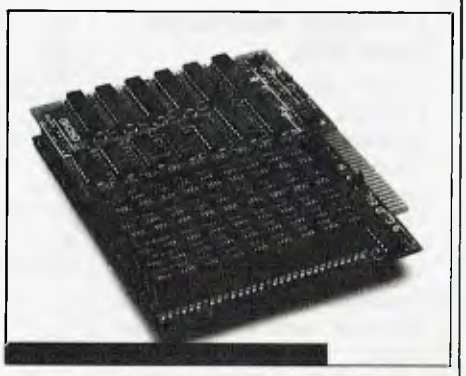
PCnet Daughtercard

This option allows connection to Orchid Technology's PCnet: the #1 Local Area Network for IBM PCs. It mounts directly onto the Conquest so that it doesn't use an expansion slot of its own.

PCnet is the most widely used PC network in the world. The reasons are PCnet is cost-effective, easy to use, and Orchid's hardware and software options meet everyone's needs. PCnet can be upgraded easily, making it a network that can grow as your needs grow. See the PCnet brochure for more information on Orchid's networking solutions.



Conquest: a multifunction board, an Expanded Memory board, and a PCnet board in one.



CramRAM brings you 2 megabytes of RAM in a half-length card. It is designed for the IBM PC/XT and uses the latest in Surface-Mount Technology.

CramRAM

2 Megabytes RAM with Lotus/Intel/Microsoft Expanded Memory in a half-card slot.

Orchid applies new technology to PC memory cards with this innovative product. Using special ICs, CramRAM puts two megabytes into a card small enough for the XT's short slot.

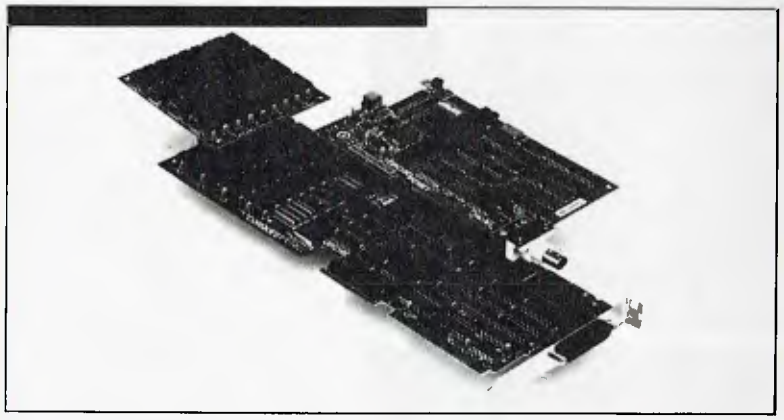
CramRAM offers up to two megabytes of memory that can be used for DOS and Lotus/Intel/Microsoft EMS. It's the perfect choice for XT owners, because it fits in the short slot, thereby saving a full-length slot for less compact boards. CramRAM preserves the computer investment by adding EMS to systems that already have multifunction cards. It brings new performance to old PCs and XTs.

Each bank of memory on the CramRAM is contained in a device called a Single In-Line Package, or a SIP. Leadless memory chips are mounted directly onto the surface of a panel with a single line of connections on one side. The SIP panels are mounted vertically on the main CramRAM card, allowing extremely dense memory packaging.

CramRAM's design makes it easy to add memory. Each SIP panel does the work of nine conventional memory ICs. Instead of inserting nine ICs (and fitting 144 pins into their sockets), just plug a single SIP panel into its easy-access socket.

An added benefit of the CramRAM's design is that it is a low power/low heat device. This extends the system's life—one more way CramRAM protects the computer investment.

Single In-line Package (SIP) panels cram up to 2 megabytes of RAM into the IBM XT's short slot.

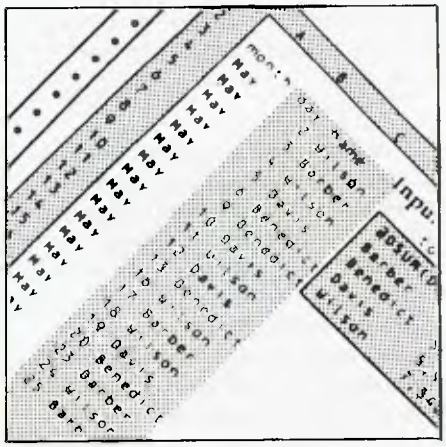


Conquest daughtercard accommodates 1 megabyte of RAM. The optional PCnet daughtercard allows hook up to the leading Local Area Network.

DEALER ENQUIRIES WELCOME

PORCHESTER COMPUTERS PTY. LTD.
177 Barkly Street, St. Kilda, 3182.
Telephone: (03) 537 2722.

Macro magic



Spreadsheet Clinic invites submissions from PC Australia readers. If you have any hints, tips or patches which you would like to pass on to other PC users, send them in to the following address, and the lucky authors of items published will receive a complimentary box of diskettes.

Spreadsheet Clinic
PC Australia
GPO Box 55A
Melbourne Vic 3001

Lotus subroutine bug

In the October issue (p. 74) Mr. Nisley writes about a bug in *1-2-3*'s subroutine call procedure. As he points out, if a macro adds or deletes lines within a worksheet, /xg or /xc commands in macros located below the additions or deletions will no longer work right if they refer to specific cell addresses. The *1-2-3* macro processor doesn't adjust cell addresses within macros when lines or columns are added or subtracted.

One way around the problem is to avoid using subroutine calls and to use named, one-cell ranges instead of specific cell addresses. Unlike cell addresses, range addresses are automatically adjusted when you change the number of columns or rows. Thus you can get the effect of a subroutine call by using a simple /xg (GOTO) command that switches control to a "subroutine" macro that begins with a named cell. Just tell the macro to branch to that named cell. If you have another named cell immediately after the original GOTO command, you can put another GOTO at the end of the subroutine to return control to the main macro at the proper location. The point is always to use named ranges.

You may, of course, end up with a lot of named ranges in your worksheets, but this is the best way to keep your macros immune to changes in the number of columns and rows. This approach is especially helpful during the development phase of a model, when you probably will be adding and deleting many rows and columns.

So long as you use named ranges within macros, you can add or subtract any number of lines without affecting your macro routines.

Francis E. Lapid

This would fix Mr. Nisley's problem. You have raised an interesting general point. It is much safer (and improves documentation) to use range names instead of cell references in macros. It not only gets around the above problem, but it also allows you to freely relocate macros as you build them without having to rewrite cell references.

Using a Macro to save a Worksheet

When you write a *1-2-3* macro that saves a worksheet, you may not always know whether there is a file of that name already on disk. If there is, the program will not immediately make the save. Instead, it will give you a menu choice: Cancel the save operation or Replace the file on disk. With most macros you're likely to want to replace any existing file. However, if you include an *r* as a part of the macro itself and the *r* isn't needed, it can cause an error in the next step of the macro. On the other hand, if you leave out the *r* and happen to need it, the macro processor will read the next line of the macro instead of the *r*, and you will get a different error.

The macro presented in Figure 1 solves this problem. When the *r* is needed, it's used, and the {esc} in line 7 does no harm at all to the worksheet. When the *r* isn't needed, the {esc} cancels it before it can do any irreparable damage.

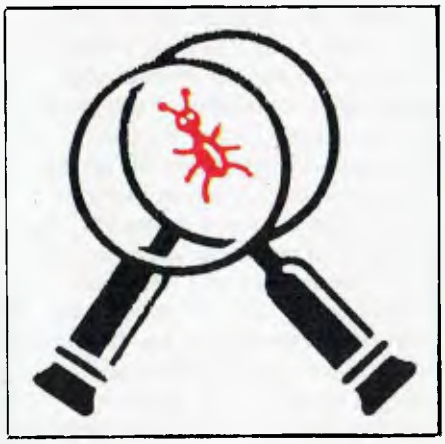
Marion Markle

It is necessary to carefully plan for different potential applications when writing a macro, and this one works very nicely for many possible file save situations in 1-2-3. Note that it could be easily modified to not allow overwriting of an existing file by changing the r on line 7 to c. SYMPHONY users can set up a similar macro, but should add an {ESC} after the {SERVICES}FS to remove the existing file name.

```
     B              C                    D
 3   \P   /xlEnter the name of the file:   ~c5~
 4        /fs
 5
 6        ~
 7        r{esc}
 8
 9          (macro . . .
10
11            . . . . continues)
12
```

Figure 1: A macro that saves a file whether or not one with that name already exists on the disk.

Let's list again



User-to-User invites submissions from PC Australia readers. If you have any hints, tips or patches which you would like to pass on to other PC users, send them in to the following address, and the lucky authors of items published will receive a complimentary box of diskettes.

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Selective updating

When copying files from my hard disk unit to a backup disk, where I only want to update the files that are already on the floppy disk, I use a batch file named UPDATE.BAT.

This batch file checks each file in the current directory for its existence on drive A: and, if it exists, copies it from the current directory to drive A:

```
UPDATE.BAT
FOR %%A IN (*.*) DO IF EXIST
A:%%A COPY %%A A:
```

Jim Smith

Store this nifty little batch in your utility sub-directory.

-

BASIC protection

BASIC allows you to protect your programs from unauthorised listing by providing the ",P" option in the save command. The following is a way to unprotect a protected program. First create a program called U.BAS by going into basic and entering;

```
BSAVE "U",0,1
```

Then load the protected program and type;

```
BLOAD "U",1124
```

Now you will be able to list the program as normal.

Colin Davids

There are many methods of unprotecting BASIC programs, and this one is simple and straightforward. After unprotecting a program that you wish to keep, save the program without the ",P" option. Leave the U.BAS program on disk in case you want to de-protect other programs.

The Parameter stops here!

This is a general hint for people who use dBase III and also make use of the parameters option for passing values to and from sub-programs. If you wish to pass a field variable to a sub-program, dBase will return you an error message "Invalid function argument", unless the field variable is part of an expression. The best way to turn the field variable into an expression is to enclose it in brackets.

The brackets concisely turn the field variable into an expression, and do so without detracting from the clarity of your code.

Maurice Collins

For those of you who use dBase III, it may not be immediately apparent from the manual that only memory variables or expressions can be included in the parameter list of a "DO <program name> WITH <parameter list>" statement. The suggested method provided by Maurice does work, but remember the value of the field variable cannot be changed by the sub-program as only memory variables receive returning values. The brackets Maurice refers to are the normal () type.

Let's List again . . .

Being a dBase fanatic from way back, I often have the need to produce listings of all programs within a particular system. I find listings easier to work from and also use the printouts as documentation.

The set of batch files shown in Figure 1 will list, using the DOS TYPE command, all files within the current directory that satisfy the specified file parameters.

Sharon Lee

This is another smart application of the DOS FOR command used in conjunction with a secondary command processor. The PRGLIST.BAT file could also be modified to print other text files. Be

```
FOR %%A IN (*.PRG) DO COMMAND /C LIST %%A

LIST.BAT

ECHO OFF
ECHO %1

                                TYPE %1 >PRN:
                                ECHO L^>PRN:
                                EXIT
```

Figure 1: PRGLIST.BAT

careful when entering the LIST.BAT file. The L^ is actually a form-feed character, entered by holding the <Alt> key down and typing "12" on the numeric keypad. This character instructs the printer to throw a new page.

Enhanced DIR

I have often wished that the directory command DIR showed the total amount of space used as well as the bytes free. This would be particularly useful when trying to find the space used by a certain application, directory or group of files. It would also be great when you are trying to free up space for a new application on a relatively full disk.

The batch file and BASIC program outlined in Figure 2 achieve this. DR.BAT uses a directory called COMMANDS and writes the chosen directory to a file called DIRLIST in COMMANDS. The BASIC program DIRECT.BAS calculates the total number of bytes used by the files, displayed one page at a time with "bytes used by these files" displayed at the end.

The command DR can be used in exactly the same way as DIR, but will show the additional information. The wild cards * and ? can be used in the normal way to display file groups.

Mark Jarzebowski, Moorabbin.

This works well, but remember that it does not take into account the size of your disk's file allocation unit (FAU). Space on your disk is allocated in chunks, known as file allocation units, and with most files there will be some space left unused in the last unit allocated. This space is not counted as part of the file size shown in the directory display. You could modify the DIRECT.BAS program to rectify this, but it may only serve to confuse, as FAUs vary according to drive type and manufacturer.

The FAU problem aside, the "bytes used" by the displayed files in a directory listing certainly is useful.

Single minded

The following hint is very helpful for people who have a multi-user system such as PC Slave, but run single user software. What is required by most people, is to be told that the software is already in use, and then to be returned to the main menu. By using the simple 1.BAT, 2.BAT (and so on) concept described in the November issue of PC Australia (User to User on page 84), the changes are very simple. It is based on testing for a file's existence. Hence, on taking a menu option (such as 1.BAT), the batch file will check for a file on the disk, say SWITCH.IN, and if it is there, continue, if not, drop out.

If the SWITCH.IN file is on disk, start the 'Yes' path by renaming the SWITCH.IN file to SWITCH.OUT. Therefore the second person will take the 'No' path in the 1.BAT file. After the 'Yes' path has been completed, rename SWITCH.OUT to SWITCH.IN.

Peter Jones, Dandenong North

This is a neat little trick that is very easy to implement. There may be a problem though. If two users select the same option at (almost) the same time, then both users could find the SWITCH.IN file absent and both try and execute IN.BAT. Of course, one user would get an error when trying to rename the SWITCH.IN file, but by then it could be too late.

The complete solution would depend on what type of operating system you are using and may involve the use of interrupts. (There are many textbooks covering hardware and software solutions to what is generally termed the "critical section" problem. Try one if you are having trouble getting to sleep at night!)

```
CLS
ECHO OFF
IF NOT EXIST SWITCH.IN GOTO OUT
IN
:OUT
REM Access denied
TYPE OUT.FIL
PAUSE
CD\
MENU

IN.BAT (Yes Path)

ECHO OFF
REN SWITCH.IN SWITCH.OUT
CD\LOTUS
LOTUS
REN SWITCH.OUT SWITCH.IN

OUT.FIL (Explanation text)

LOTUS is already in use!
```

Figure 3: 1.BAT

```
REM ***** DR.BAT — ENHANCED DIRECTORY DISPLAY
DIR %1 >\COMMANDS\DIRLIST
ECHO OFF
BASICA\COMMANDS\DIRECT
MORE <\COMMANDS\DIRLIST

DIRECT.BAS

5 REM ***** BASIC PROGRAM "DIRECT"
6 REM ***** TO CALCULATE SPACE USED BY DIRECTORY FILES
10 D=0
20 OPEN "\COMMANDS\DIRLIST" FOR INPUT AS #1
30 INPUT #1,A$
35 IF EOF(1) THEN GOTO 100
40 B$ = MID$(A$,14,8)
50 C = VAL(B$)
60 D = D + C
70 GOTO 30
100 CLOSE
120 OPEN "\COMMANDS\DIRLIST" FOR APPEND AS #1
130 PRINT #1,"              ";D"bytes used"
140 CLOSE
150 SYSTEM
```

Figure 2: DR.BAT

AUSTRALIA

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TECH NOTEBOOK

10

Turbocharged screens

Joseph Louderback describes a method to generate extremely fast screen output using Turbo Pascal.

Turbo Pascal offers several ways to do very fast screen output. You can store screen images in arrays of records and move them into and out of screen buffers, but arrays take up space in Turbo's 64K data segment.

The listing below, RAPIDSCR.PAS, offers a fast alternative that does not deplete the data segment. The technique stores each screen image in the heap. The size of the heap is limited (roughly) only by the physical memory of the PC. As soon as the images are in the heap, it is a simple matter to recall any of them to the screen instantly.

RAPIDSCR first writes four screens using Write statements, then saves each image in the heap. Once all screens have been saved, pressing any key loads them to the screen from heap immediately.

For brevity's sake, RAPIDSCR generates its screens from string literals embedded in the program code. The wisest course is to store text screens as text files on disk, and then read them from disk and immediately store them out to the heap. This method does not even require space in the code or data segment for string literals, as demonstrated here. It also allows the user to change screen displays without recompiling the program.

In a modern PC that contains 640K RAM, the largest memory resource in a Turbo Pascal program is the heap. Used wisely, the 64K limitation of the data segment becomes much less important. ■

Joseph Louderback is a professor of accounting

LISTING: RAPIDSCR.PAS

```
{$C-,U-}
program RapidScreen;

TYPE StuffInHeap = ^PutInHeap;          {Pointer to screens}
     PutInHeap = Record                 {Record of images}
                   ScreenImage : Array[1..4096 ] of Char;
                 End;
VAR Ch : Char;
    ColorPage : Array[ 1..4096 ] of Char Absolute $B000 : $0000;
    {This program uses the color screen location.  Change the
    above value to $B000 : $0000 for the monochrome screen.}
    Screen: Array[ 0..3] of StuffInHeap;
    J : Integer;

Procedure WaitForKey;
BEGIN
  REPEAT Read (Kbd,Ch) UNTIL Not KeyPressed;
END;

Procedure Message;  {Asks for keypress for next screen or quit}
BEGIN
  GoToXY(10, 25);
  Write
  ('Press Enter to stop; any other key steps through screens.');
  WaitForKey;
END;

BEGIN {main program}
TextColor(0); TextBackGround(7);
ClrScr;
Write('Screen 0 contains only this line.'); {Write screen 0}
New(Screen[0]);                 {Allocate screen in heapspace}
Move(ColorPage, Screen[0]^.ScreenImage, 4096);  {Store screen }
TextColor(4); TextBackGround(2);      {Attributes for screen 1}
For J := 4 to 15 Do
  BEGIN
    GoToXY(4, J);                               {Write screen 1}
    Write(Chr(186),'Screen 1 is this material.',Chr(186));
  END;
New(Screen[1]);                         {Allocate another screen}
Move(ColorPage, Screen[1]^.ScreenImage, 4096);  {Store screen }
Textcolor(12); TextBackGround(4);
For J := 12 to 22 Do
  BEGIN
    GoToXY(18, J);
    Write
    (Chr(186),'We add this to get screen number 2.',Chr(186));
  END;
New(Screen[2]);
Move(ColorPage, Screen[2]^.ScreenImage, 4096);
TextColor(14); TextBackGround(0);
For J := 15 to 20 Do
  BEGIN
    GoToXY(32, J);
    Write(Chr(186),'And now all of this is screen 3.',Chr(186));
  END;
New(Screen[3]);
{Here we bring screen 3 in from heap:}
Move(ColorPage, Screen[3]^.ScreenImage, 4096);
REPEAT
  Message;              {User presses any key to get next screen}
  If Ch <> ^M Then
    BEGIN               {Bring screen 0 from heap: }
      Move(Screen[0]^.ScreenImage,ColorPage,4096);
      Message;
    END;
  If Ch <> ^M Then
    BEGIN               {Now bring screen 1 from heap: }
      Move(Screen[1]^.ScreenImage, ColorPage, 4096);
      Message;
    END;
  If Ch <> ^M Then
    BEGIN               {Now bring screen 2 from heap: }
      Move(Screen[2]^.ScreenImage, ColorPage, 4096);
      Message;
    END;
  If Ch <> ^M Then    {Now bring screen 3 from heap: }
    Move(Screen[3]^.ScreenImage, ColorPage, 4096);
UNTIL Ch = ^M; ClrScr;
END.
```

TECH NOTEBOOK

11

Self-installing software

Ted Mirecki explains that the key is an assembly language routine that reports system configuration.

Most of today's software packages must be installed on a particular hardware configuration before they will perform at their best, but what about the user who needs to run one package on a number of different systems? The installation could be performed again and again for each use; however, this would soon become a bother, and forgetting the process might require a cold restart.

The ability to install software on a variety of systems can be automated by means of a batch file, if the batch procedure is able to branch conditionally according to the configuration of each new system. The most useful method of branching in batch files uses the IF ERRORLEVEL statement, where the value of ERRORLEVEL is returned by a program that determines the hardware configuration of the system. **The example given here** shows the automatic installation of *Lotus 1-2-3* on either a monochrome or a color/graphics system, but the principle is readily extendable to other programs with installations that depend on any hardware characteristic detectable by an assembly language program.

The installation of *Lotus 1-2-3* involves the copying of both text and graphics driver files. Normally, the user must specify whether a monochrome or a color/graphics display is being installed so that those drivers appropriate to the specified display may be copied. The procedure presented here determines this automatically, then performs the required installation of drivers based on the video mode of the system. The key is the assembly language program VIDMOD, which determines the video mode (monochrome or graphics) and returns it as the value of ERRORLEVEL. A batch file can then branch on this value and copy the driver files.

Because VIDMOD is such a simple program, it is most easily created with the assembly feature of DOS DEBUG. Type in the boldface text shown in the figure. The program locates the video mode in location 40:49 of the BIOS data area and returns the value of this mode to the calling process (in this case, the DOS batch file) by placing the value in register AL and exiting with INT 21H, function 4CH. The ERRORLEVEL statement then tests the value of this return code.

The presence of a graphics driver is used to determine whether a monochrome or a color/graphics display is installed. If a monochrome card is active, VIDMOD returns a value of seven into ERRORLEVEL; if a color/graphics adapter is active, a value less than seven is returned. The batch file LOTUS.BAT uses this value of the video mode returned by VIDMOD to determine its branch between one of two installation sequences. The installation procedure is skipped if the current configuration is the same as the new one. A review of the listings MONO.BAT and COLOR.BAT, both on the Lotus utilities disk, will clarify this installation procedure.

To use this method with release 1A, rename file LOTUS.COM to LOTUSX.COM on the *1-2-3* system disk, and copy VIDMOD.COM, LOTUS.BAT, IBM0MONO.DRV, IBM1G2.DRV, AND IBM0COLO,DRV from the utility disk to the system disk. Copy IBM0MONO.DRV to TD.DRV before executing LOTUS.BAT for the first time,

This scheme may be extended for use with any two-way or multiway branch on any hardware characteristic: memory size, the presence of both monochrome and color/graphics adapters simultaneously, the number of printers or serial ports, an 8087 processor, or the type of computer. ■

Ted Mirecki has a master's degree in computer science

FIGURE: *VIDMOD*

```
debug vidmod.com
File not found                  ;ignore this message
-A 100
xxxx:0100 MOV AX,40
xxxx:0103 MOV DS,AX             ;set DS to ROM data segment
xxxx:0105 MOV AL,[49]           ;get video mode into AL
xxxx:0108 MOV AH,4C             ;exit w/return code in AL
xxxx:010A INT 21
xxxx:010C                       ;just return on this line
-R CX                           ;set length of file
:C
-W                              ;write it to disk
Writing C bytes
-Q                              ;leave debug
```

LISTING: LOTUS.BAT

```
echo off
vidmod
if errorlevel 7 goto mono
:color
if exist gd.drv goto done
echo Loading color/graphics drivers
copy ibm0colo.drv td.drv
rename ibm1g2.drv gd.drv
goto done
:mono
if exist ibm1g2.drv goto done
echo Loading mono drivers
copy ibm0mono.drv td.drv
rename gd.drv ibm1g2.drv
:done
echo on
lotusx
```

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TECH NOTEBOOK

12

Breakpoints in BIOS

Exploring the ROM BIOS can be great fun, but how can you set breakpoints? Ted Mirecki describes one solution.

The ROM BIOS routines are a treasure trove of information about the nitty-gritty details of IBM PC systems. To understand these routines, it is best to trace through the code with a debugger. The DOS DEBUG program will single-step through the BIOS, but breakpoints cannot be set in ROM because doing so requires that code be replaced by breakpoint instructions. MOVROM.ASM copies the BIOS to RAM, makes it resident, and repoints all BIOS interrupts to the copied code, thus allowing any debugger operations to be performed.

This routine copies the system BIOS for the PC or PC/XT, but it may be modified to copy any other ROM code. The segment is entered at label ROMSEG, the beginning off-set at ROMBEG, and one past the end of the ROM code at ROMEND. If the ROM code extends to the end of the segment, the ending offset is entered as zero.

After the program is assembled, it must be linked with the/HIGH parameter. This ensures that the area just above DOS is free to receive the ROM code. The program repoints ROM interrupt vectors to RAM. MOVROM must be executed before any resident utilities are installed, because such utilities repoint BIOS interrupts to themselves. When MOVROM exits, it displays the segment where it copied the ROM code; the offset is the same as in the original BIOS listing. ■

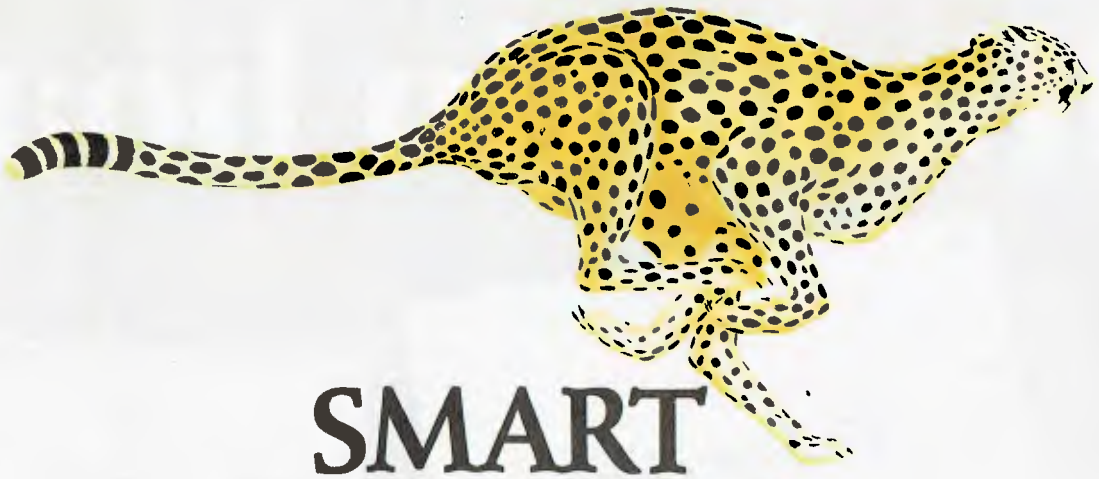
Ted Mirecki is a corporate planner, responsible for developing decision-support systems.

LISTING: MOVROM.ASM

```
STACK   SEGMENT STACK
        DW      128 DUP(0)
STACK   ENDS

ASMUTIL SEGMENT BYTE PUBLIC 'CODE'
        ASSUME  CS:ASMUTIL, SS:STACK
ROMSEG  DW      0F000H          ;ROM's segment
ROMBEG  DW      0E000H          ;starting paragraph
ROMEND  DW      0               ;ending paragraph
MESSG   DB      'ROM code moved to segment '
SEG$    DB      0,0,0,0,'$'

MOVROM  PROC    FAR
        MOV     AX,DS           ;get PSP segment
        ADD     AX,6            ;first avail. paragraph
        MOV     BX,CS:ROMBEG    ;get starting offset
        MOV     SI,BX           ;point to source offset
        MOV     DS,CS:ROMSEG    ;get source seg into DS
        MOV     CX,4
        SHR     BX,CL           ;starting paragraph
        SUB     AX,BX
        MOV     ES,AX           ;destination segment
        MOV     DI,SI           ;dest. offset same as source
        MOV     BX,SI           ;save it in BX
        MOV     CX,CS:ROMEND    ;calc word length in CX
        SUB     CX,SI           ;CX is ROM length
        SHR     CX,1            ;convert to word length
        JNZ     SAVLEN
        MOV     CH,80H          ;if zero, set to 1/2 segment
SAVLEN: PUSH    CX              ;save word length
        REP     MOVSW           ;move ROM to low memory
        MOV     AX,DS           ;point AX to ROM segment
        MOV     DX,ES           ;point DX to new segment
        MOV     SI,BX           ;reset SI to start of new code
        XOR     BX,BX           ;DS:BX points to intrpt table
        MOV     DS,BX
        MOV     CX,100H         ;no. of interrupts in table
        DEC     DI              ;DI = last byte of moved code
SCNINT: CMP     AX,[BX+2]       ;int points to ROM segment?
        JNE     NXTINT          ;no, go look at next int
        CMP     [BX],SI         ;int offset past start?
        JB      NXTINT          ;no, go look at next int
        CMP     [BX],DI         ;int offset before end?
        JAE     NXTINT          ;no, next int
        MOV     [BX+2],DX       ;yes, set new segment
NXTINT: ADD     BX,4            ;point to next int
        LOOP    SCNINT
        MOV     AX,CS           ;point ES & DS to code segment
        MOV     DS,AX
        MOV     ES,AX
        ASSUME  DS:ASMUTIL, ES:ASMUTIL
        MOV     AX,DX           ;new segment value to AX
        MOV     DI,OFFSET SEG$  ;point DI to HEX char string
        CALL    AX2HEX          ;convert seg to characters
        MOV     DX,OFFSET MESSG ;display sign-off message
        MOV     AH,9
        INT     21H
        POP     DX              ;restore ROM length in words
        ADD     DX,7            ;round up to next paragraph
        SHR     DX,1            ;convert to paragraphs
        SHR     DX,1
        SHR     DX,1
        ADD     DX,6            ;adjust for prefix
        MOV     AX,3100H        ;fix ROM code in memory
        INT     21H
MOVROM  ENDP
        ASSUME  CS:ASMUTIL
AX2HEX  PROC    NEAR
        CLD                     ;go forward through strings
        MOV     BX,OFFSET HEX   ;point to hex digit chars
        MOV     CX,4            ;will handle 4 nibbles
NXTNIB: ROL     AX,1            ;hi-order nibble to lo-order AX
        ROL     AX,1
        ROL     AX,1
        ROL     AX,1
        MOV     DX,AX           ;save it in DX
        AND     AL,0FH          ;isolate low-order nibble
        XLAT    CS:HEX          ;translate to hex digit
        STOSB                   ;put hex digit into output
        MOV     AX,DX           ;recover AX value
        LOOP    NXTNIB          ;repeat for 4 nibbles
        RET
AX2HEX  ENDP
HEX     DB      '0123456789ABCDEF'
ASMUTIL ENDS
        END     MOVROM
```



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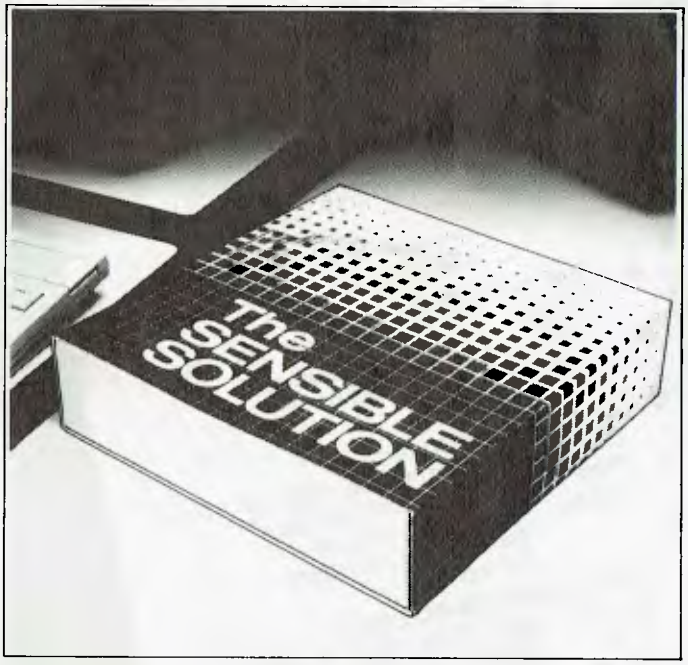

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COMPSOFT Australia Pty Ltd 417 Wickham Tce. Brisbane, Qld 4000 Tel: (07) 839 0066. TLX: 41181

PC Australia Bulletin board

PC User Groups

MELB-PC
Contact: Tim O'Connor (03) 830 5067
Time: 6.00pm second Wednesday
Venue: Clunies-Ross House
191 Royal Parade
Melbourne

Sydney PC User Group
Contact: Ana Calligeros (02) 290 3655
Time: 5.45pm third Monday
Venue: Price Waterhouse
11th Floor, 50 Bridge Street
Sydney

Perth PC Micro Users Group
Contact: Tony Farrell (09) 481 0011
Time: 5.30pm first Tuesday
Venue: CTA
54 Havelock Street
West Perth

IBM-PC Users Groups (SA)
Contact: Don Richards (08) 261 9590
Time: 7.30pm first Thursday
Venue: 173 Wakefield Street
Adelaide

ACT PC Users Group
Contact: Nick Hammond (062) 86 1102
Time: 8.00pm fourth Monday
Venue: Main Lecture Room
Canberra TAFE (Reid)
Canberra

The Illawarra IBM-PC Club
Contact: Ken Jeffrey (042) 74 0442
Time: 7.30pm first Tuesday
Venue: John Lysaght
Springhill St Training Centre
Port Kembla

CHARTBUSTERS!
Don't miss the PC Australia Top Ten [Page 15]

BBS Directory

Victoria	
PC Connection IBBS	(03) 528 3750
HiSoft IBBS	(03) 799 2001
Computers Galore	(03) 561 8497
The National (5pm-9am)	(03) 818 1934
Down Under	(03) 429 5819
New South Wales	
PC Exchange	(062) 58 1406
PC User Group	(02) 238 9034
Micro Design Lab	(02) 663 0150
Sydney Public Access	(02) 808 3536
Prophet RBBS	(02) 628 7030
Dick Smith IBBS	(02) 887 2276
South Australia	
Adelaide User Group	(08) 271 2043
Computer Ventures	(08) 255 9146
Queensland	
Competron	(07) 52 9498

APPLICATION SOFTWARE GROUPS

Multiplan Users Group
Address: PO Box 95
Forestville NSW 2087
Contact: Richard Womack (02) 997 1554.
Meetings: 6.15pm 2nd Wednesday
MTE Centre, 2nd Floor
Cnr York and Market Streets
Sydney

dBase Users Group
Address: PO Box 297
Neutral Bay Junction NSW 2089
Contact: Maria Lengas (02) 908 3458
Meetings: 6.30pm 2nd Tuesday
Cowper Room, St Andrews House
near Town Hall Station
Sydney

NOTICE

If you have any further PC community information for this bulletin board, Contact the Editor, Ian Robinson on (03) 6024122

PC AUSTRALIA The interactive guide to IBM PCs and compatibles

Turbo Pascal User Groups

Victoria
Address: PO Box 81
East Caulfield Vic. 3145
Contact: Ron Savage (03) 651 1414
Meetings: 7.00pm 1st Wednesday
Institute Function Room
Union Building, RMIT

Western Australia
Address: 73 Outram Street
West Perth WA 6005
Contact: Aaron Regan (09) 322 1834
Meetings: 7.30pm 2nd Tuesday
2/294 Rokeby Road Subiaco

SPECIAL INTEREST GROUPS

The PC User Group in Sydney has spawned a number of special interest sub-groups (SIGs), which meet monthly at the Coopers & Lybrand Auditorium in Bligh Street at 5.45 pm on the following dates:

GENSIG — General Discussion Group — first Tuesday. Contact: Catherine Rosenbrauer (02) 290 3655

COMSIG — Communications Group — second Monday. Contact: Geoff May (02) 699 3518

DATASIG — Database and Spreadsheet Group — fourth Tuesday. Contact: John Pitera (02) 499 2400

Lotus User Groups

Melbourne
Contact: Robert Taylor (03) 267 4800
Time: 5.30pm first Tuesday
Venue: Light Car Club
46 Queens Road
Melbourne

Sydney
Contact: Ron Pollak (02) 290 3655
Time: 5.45pm first Thursday
Venue: Deloitte Haskins & Sells
7th Floor, 16-18 Bent Street
Sydney

Adelaide
Contact: Paul Wragg (08) 223 5711
Time: 7.30pm first Tuesday
Venue: 173 Wakefield Street
Adelaide

Perth
Contact: Peter Foreman (09) 322 4899
Time: 5.30pm first Tuesday
Venue: Australian Bank
2nd Floor, 190 St George's Tce
Perth

Brisbane
Contact: Bill Savage (07) 221 2144
Time: 5.30pm first Tuesday
Venue: Duesbury's
28th Floor, 239 George Street
Brisbane

The who, what, when and why of the leading consultants in the field of small computing.

Who?

Q "Ron Pollak & Co! Couldn't you think of something more imaginative; like 'CONSULTING TRAINING & DEVELOPMENT CORP'? A name that at least tells what your organisation does."

A "Quite right. We have stuck with the name for a number of reasons, including:
- we are proud to put our name on every assignment because as professionals our reputation is of primary importance
- it provides a personal profile; at least you know the name of someone in the firm to call when you want immediate action."

What?

Q "What do Ron Pollak & Co do?"

A "We develop software, consult, implement accounting software packages and train users in the use of microcomputers, spreadsheets or data base software."

When?

Q "How fast can you react to our needs?"

A "How soon do you need us? We have top consultants available immediately.

Where?

Q "Do you deliver results?"

A "Good question! But don't ask us, speak to our clients. See why we are engaged by leading banks, finance companies, computer companies, accounting firms, construction companies, stock brokers, importers, manufacturers, retailers, government bodies, transport companies and a host of other organisations."

Q "Why don't you give the name of your clients?"

A "Competitive advantage. Why tell our competitors which of Australia's top companies use our services? But should you contact our office we would be pleased to provide references.

Why?

Q "Now have I got it straight? Ron Pollak & Co consult, develop software, develop financial models, train people in the use of PC products and install accounting software."

A "Right."

Q "You claim to be Australia's leading small computer system consultants and you have some very good people in your organisation. Your client base and the range of assignments undertaken appear very impressive. Are you available to meet with us today?"

A "Your place or mine?"

Ron Pollak & Co
Management Consultants

8th floor 14 York Street Sydney NSW 2000 Telephone (02) 290 3655 Telex 02071 10712881

Online innovations

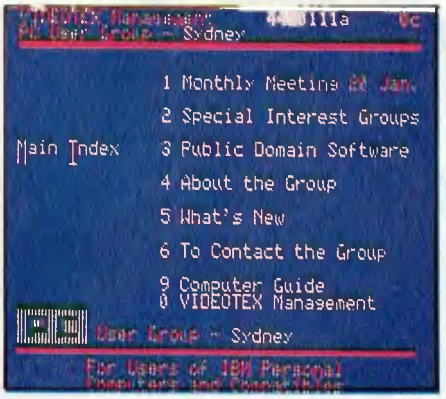
Regular readers will recall me raving on some time back about the flight simulator game which can be found (after a good deal of hunting around) on Viatel. I recently had the good fortune to run into the programmer who devised this better-than-average videotex game and found that — surprise, surprise — it was written in Australia on an IBM PC compatible!

I must (ashamedly) admit that, when I originally discovered the videotex flight simulator, I immediately assumed it was an imported product like so much other material on Viatel.

The programmer told me how each simulator frame was generated by a special program, to yield a frame for all of the possible permutations and cockpit views. Because of the automatic screen generation methods employed, there are several frames that are impossible to enter during the normal course of play. Mind you, this has not stopped the occasional enterprising hacker from jumping directly to the "illegal frames" from Viatel. One of the reasons that Viatel has become a hackers' playground is because there are far more frames existing than are indicated by the various menus.

The initial marketing of the flight simulator was achieved along similar lines, a standard message being sent to every Viatel subscriber at the time the program was launched. Again this was done through a simple PC program. Like all games, the initial popularity waned, after all the potential videotex pilots had reached 'ace' status and become bored with it. The program will eventually disappear from Viatel, because all those pages cost a fair amount to rent. So if you haven't taken a look yet, check it out.

On the subject of local videotex innovations, I have noticed advertisements for a portable videotex terminal, based on the Toshiba T1100



laptop portable, an acoustic coupler and the Multicom software. What a great idea! Although the monochrome LCD screen display would present problems, the prospect of tapping into Viatel or other videotex systems from a phone booth or hotel room is appealing.

I have talked about videotex service innovations, videotex marketing innovations and now a few words on what will perhaps have the greatest impact on the future of the industry. Photo Videotex is coming to Australia!

Photo Videotex is a high-resolution videotex system just released by the original developer of Prestel, British Telecom. Photo Videotex allows color photographic images to be displayed along with text and graphics. A Photo videotex system released by the system (which can be a PC AT), plus editing terminals and user terminals. Specially designed expansion boards convert IBM PCs (or compatibles) into editing or user terminals.

A full-size color picture would require 64K for storage after data compression and pictures are displayed at a resolution of 270 by 240 pixels, with a palette of two million colors available. RGB input signals, either from a camera or a decoded PAL video signal, are converted into luminance and color difference components, yielding a 128K image which is then compressed using previous element DPCM to 64K. If this is all getting a bit too technical, take it from me that the resulting images look terrific.

As would be expected, speed is a bit of a problem for such a system and a full screen color picture is displayed in just under 10 seconds, assuming a transmission speed of 64 Kbits/second. (Black and white images would only require half this amount of time.) But this sort of breakneck speed can only be achieved through systems such as ISDN or cable television networks. If the standard telephone network is used, speeds of 4800 or 9600 baud are more likely, and the display times will be correspondingly slower.

British Telecom is wisely marketing Photo Videotex initially based on the IBM PC and AT family, making it inherently portable to other systems at a later stage. Local distribution has been picked up by Syscorp Pty Ltd, which currently markets several other PC videotex products. A user terminal based on the IBM PC would require a set of three expansion cards — picture storage card, videotex generator card and an X21 communications card. An editing terminal would require all of these as well as a PAL decoder and an input card, so an XT or compatible is desirable. The text and graphics which may be added to the picture image are compatible with the Prestel standard.

The editing terminal software, written in Pascal and assembler, allows image capture, cropping, reducing, moving, and transfer to other pages. Brightness, contrast and color may also be manipulated, and the terminal can be used in a standalone mode with a carousel of images from its local database.

So pioneering PC videotex users, who have up to now had to live with a fairly antiquated system, can take heart in the fact that at last some exciting new technology is in the pipeline.

PC Disk No: 1 is here!

Help fight R.S.I.!

Are your fingers getting tired of typing in all those amazing PC Australia listings? Do they repeatedly trip over the keys in the excitement, generated by the discovery of the new found programming gems? Do you yearn to unleash the power of the PC Australia program listings, but hesitate when faced with the daunting task of keying them in to your own PC? Well, you need worry no more–because all of the program listings from the last three issues of PC Australia (October, November and December) are now available on a PC-standard 5.25-inch floppy disk! Why bother keying in one more character, when you now have the functional, fully-tested software readily available?

Program listings, patches and code fragments from *User-to-User*, *Spreadsheet Clinic*, and feature articles are all included on the disk, along with the absolutely indispensible *PC Tech Notebook* listings. For the incredibly low price of $9.50 (including postage and packaging), you can save yourself hours of potential keyboard agony. Help fight R.S.I. now–buy the PC Australia program listing disk.

NOTE PC Australia listings are supplied on top quality 3M disks, which come with a 100% error-free lifetime guarantee from 3M.

To: Freepost No. 80, PC Australia, GPO Box 55A, Melbourne Victoria 3001.

I enclose my cheque for $9.50 (inc. P&P) payable to PC Australia

Or charge to ☐ American Express ☐ Bankcard ☐ Diners Club

Card No: ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

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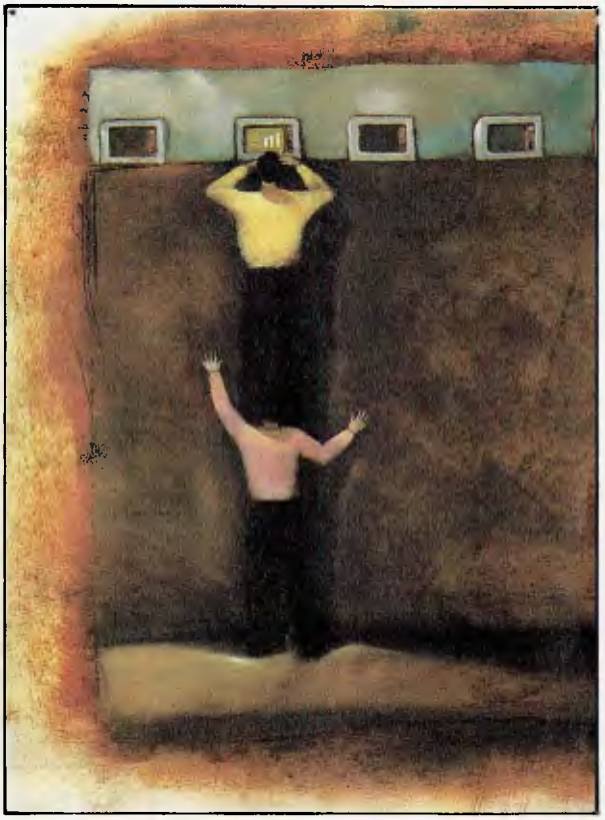
Signature: _____

Coming up



The March edition of *PC Australia* looks set to be our biggest issue yet, and will feature the third part in our ongoing PC expansion board series, this time dealing with color graphics boards. Les Stein looks at several programs which could best be described as 'lifestyle software', including a fitness program, a diet program and even one that teaches the PC user how to be an expert blackjack player.

In the March issue we will also be announcing the second of our *PC Australia* program listing disks. Disk #2 will include all of the listings featured in the January, February and March issues of *PC Australia*, so that readers can simply load the software, rather than laboriously typing it in.

Clive Lassiter will be back with a report on another hot PC compatible, John Green will present more spreadsheet hints in Spreadsheet Clinic, Ron Pollak introduces further software tips and patches in User-to-User, Vi Adelle reports on the PC videotex world and Ian Robinson presents the latest PC News.

Rip offs-American style

Do you have a great idea for a new program? Something up your sleeve that is so novel and exciting you get goosebumps just thinking about it? Do you dream of how the paltry day-to-day routine will be exploded in fireworks of fame and glory? Forget it mate!

Don't get me wrong — I have no loathing for gigabucks and unbounded fame. I spotted Robert Redford last week in a New York clothing store trying on $2000 suits, surrounded by bodyguards and dribbling supplicants, and decided I could easily handle a bit of that.

Unfortunately, developing a computer program is a shortcut to the grave. It will turn you into a twitchy sycophantic slob who counts palpitations through the night. The computer indusry is controlled by a coterie of ruthless bastards who make Mafia hitmen look like Cabbage Patch Kids. You have to slide on your belly and lick their shoes to get your foot in the door. Want to go in standing up with your integrity intact? Hah! They have what you want — the venture capital, the name, distribution channels and so on, and they are not likely to hand it over without you compromising every vow you ever offered.

This is not speculation. For the last three years I have been developing a program. Don't expect me to give you any hints about it. The last time I wrote to a major company with a blockbuster concept, they wrote back and said "Co-incidentally, we have the same program in progress." Yeah, sure!

When I first approached a MAJOR software house I was as naive as a kitten. I expected a fawning company president to apologise for taking ten seconds to hand over the cheque. After an hour's wait, a deputy assistant marketing manager brought me into his office. He was the kind of sleazy crumb that makes you count

your fingers after you shake hands. He leaned and over and said "Look, I'll gladly show your program to the manager, but I want two grand for myself to do it."

I went berserk and threatened to knock out his dentures. A bigger but even sleazier cheese came in to see what the fuss was about and said "There you are — I've been waiting for you for over an hour." The twilight zone. I was told to leave a copy of the program and they would get back to me in a week. I happened to have my own airtight agreement with me which he signed. I never heard from them again and each phone call was placed on indefinite hold. I finally went back to the company office and a new sleazoid came out and told me that they never heard of my program and that the two gorillas had moved elsewhere.

Now I understood. I hired a slick-talking agent — a full-time charismatician — to approach another company on my behalf. This time we had demos, slides, market reports and new hope. They loved it and, yes, they were interested. Would I take three per cent of the net? No, I am not so greedy as to want portholes on my coffin. But I want more — give me more!

This all took place in Oz where we simply are not used to lighting our cigars with hundred dollar bills. America, I thought was the place for a smart boy to make a few bickies. There, when the going gets tough, the tough go shopping. Overt greed is part of the local idiom, and anyone is permitted to ruin the next guy in the rush to the trough.

I could not even get beyond secretaries on the phone. The big shots like, Lotus and Ashton-Tate, get thousands of calls from low-life software developers. To them, you are just another poor schnook. They have stacks of their own ideas and are not remotely interested in committing their resources to your ambition.

Now, I never said it was totally hopeless. A few local ventures such as Attache and FBN Software seem to have made it in America. The odd small operation sometimes bubbles up from the ooze and flares for a second or two before disappearing. Ignoring development expenses, it will take about $100,000 for preliminary advertising, and a good product can expect to sell maybe 3,000 copies. There is too much competition to sell much more, unless you have produced the computer equivalent of the Bible. How do you even get that far?

The lesson is that hard work and brilliance will probably get you nowhere. Insight into the industry and marketing expertise are worth nothing. You need another quality. The ability to convince the software godfathers that they are witnessing a divine birth. You have to develop a mystical sincerity about your product that comes from a fanatical belief that you are Midas. Do you have that?

If not, how do you get it? I am not sure. Perhaps the answer lies in the comment to me of a successful entrepreneur: "the most important thing in this business is sincerity — when you can fake that, you've got it made!"


Microsoft Chart
Complete Business Graphics Program
Program Disk
For IBM
Personal Computer
Disk 1 of 2
Microsoft Word
Word Processing Program
Utilities Disk
For IBM
Personal Computers
Disk 2 of 3
Program Disk
For IBM®
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Word Processing Program
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Microsoft Project
Project Scheduling and
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Personal Computers
Disk 1 of 2
"Microsoft's programs are so popular you'd think they wrote the operating system for the IBM PC."
Indeed, we did.
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What's more: we have recently signed a long-term agreement with IBM that means we will continue the joint development of operating systems and other systems software for the industry's most successful PC.
Microsoft is to software what IBM is to hardware: The industry standard.
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The industry standard word processor (comes with Spell™).
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Microsoft Windows™
The industry standard you've all been waiting for.
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The industry standard pointing peripheral.
Microsoft Flight Simulator™
The industry standard – period
(voted Your Computer's Software Product of the Year for 1984).
For any information call us on (02) 452 5088 or toll free on (008) 22 6850.
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John Bevins M17
For IBM® Personal Computers
D-072
System Requirements:
192K memory, DOS 2.0 or higher
one double sided disk drive.
052099. 200
Learning Microsoft® Word
Mouse Version
MICROSOFT
Microsoft R Base 5000
Relational Data Based
Management System
Program Disk
For IBM
Personal Computer
Disk 1 of 2
Program Disk
For IBM®
Personal Computers
Disk 2 of 2
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Microsoft
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Operating Environment
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For IBM
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